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ON TWO FORMS OF AUTOMATIC MICROTOMES.

IT is proposed to describe two microtomes, one of which has already been widely used; the other, on the contrary, has been put on the market very recently. The older instrument may be known as the 'automatic wheel microtome;' the new one has been named the 'precision microtome,' and is also planned to work automatically.

A microtome is an instrument of precision, which implies that it must be treated with extreme delicacy and kept most scrupulously clean. It will be found usually, when complaint is made against a microtome, that the complaint is misdirected and ought to be, not against the machine, but against the owner. A modern microtome necessarily has several adjustments, every one of which must be exact and secure. If any one of them is imperfect and insecure; if any of the movable parts are allowed to become corroded, or gummed up with oil, or loose, or clogged with dust or dirt of any kind, the microtome will not and can not work as an instrument of precision.

The knife used for cutting ought to be regarded as an integral part of the microtome, and as its most delicate and easily injured part. In accordance with this view, there has been added a description of a new form of knife, which offers certain substantial advantages.

I. THE AUTOMATIC WHEEL MICROTOME

This instrument was designed in 1886 and was first made by G. Baltzer, the trusted instrument-maker of Professor Carl Ludwig. Baltzer, who died recently, continued for many years to furnish apparatus for the Physiological Laboratory in Leipzig, and had, therefore, unusual experience in the practical construction of new instruments. The first automatic microtome made by him is still in active service in my laboratory. Experience suggested various minor improvements, which have contributed to render the microtome more accurate and more convenient. Besides the changes which I have introduced, there have been several proposed by Professor Wilhelm His and by Dr. Spalteholz, which have proved especially valuable. It is remarkable that very few available suggestions have been made by the mechanics who have manufactured the machines hitherto. The most important change, I consider, to have been the increase in the heaviness of the construction, for it secures greater rigidity, a quality of great importance when very thin sections are desired.

Mr. Francis Blake, of Weston, Massachusetts, is engaged in improving the mechanical construction of the instrument. The changes proposed by him will prove, I think, of great value.

The automatic microtome is now made in Boston, by the Franklin Educational Company; Leipzig, by E Zimmerman; Paris, by E. Cogit; Cambridge, England, by the Cambridge Instrument Company.

Over two thousand are now in use. I believe that the instruments are in all cases well made. I have not, however, had an opportunity of testing myself those made in England. The first instruments made in America were not wholly satisfactory, but I believe them now to be made in this country fully as well as elsewhere, and there are certain details in the American design, as at present followed, which render it, in my judgment, preferable to the European models. The illustrations give two views of the American microtome, as now made. The general principle of the instrument is to keep the knife fixed, and to move the object to be cut in a vertical direction, supplying it to the knife by an automatic feed. The knife is carried by two upright standards, united by two cross bars; in the American microtome these are all a single casting; in the German they are four separate pieces screwed together, and, therefore, less securely rigid. The two uprights can be adjusted as to their distance from the object to be cut. The object, imbedded in paraffine, is attached to a brass plate, which can be securely clamped at any desired angle in the machine. The motion of the apparatus is imparted by a wheel, which may be turned by hand, or by a water or electromotor, but the hand-power is the most satisfactory. The wheel is made considerably heavier and is better balanced in the American model than in the others, so that the machine works more smoothly and evenly to the sensible improvement of the cutting. The wheel turns the axle to which it is attached, and at the opposite end of the axle is a crank working a slide, which raises and lowers the vertical carriage. This carriage is held by adjustable gibs against the vertical ways; it carries on the side toward the knife the object-holder, with its adjustments to fix the plane of the sections; it also carries the horizontal microtome screw. The head of the micrometer screw is a tooth-wheel, each tooth corresponding to a feed of $\frac{1}{100}$ mm. The screw is turned by a pawl, which acts upon the toothed-wheel; the pawl is worked, as may be readily seen in Fig. 2, by the vertical motion of the carriage, and the number of teeth caught at each rise of the carriage may be varied mechanically from one to six. The American form of pawl is simpler,

more certain and accurate, and less liable to get out of order than the foreign form.

The Zimmerman microtomes are of a very high grade of workmanship, and I can recommend them with confidence, having thoroughly tested them. The Cogit microtome also appeared to me thoroughly good, but I have had no opportunity to test one by prolonged use. Zimmerman has added to the microtome, as made by him, an attachment to give a feed of 0.001 mm., but it seems to me that the addition is of slight value, since the accuracy of the instrument cannot be carried so far, because with vertical ways the precision of movement cannot be made so great. No doubt such sections (of 0.001 mm.) can be made with the machine, but if the object offers any difficulty from its size or its hardness the machine will fail. For very fine work another type of microtome is called for.

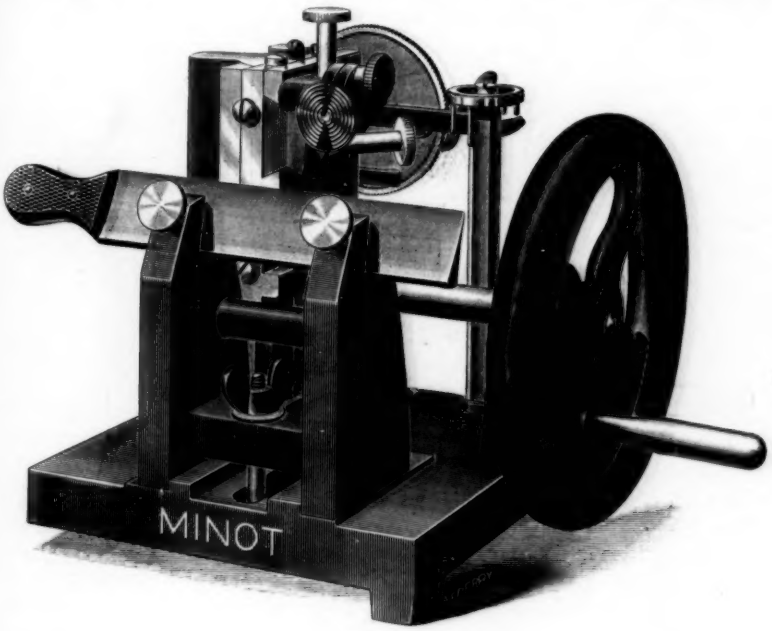

FIG. 1.

The automatic wheel microtome will cause only vexation and disappointment if it does not receive the utmost care. I will, therefore, mention the most necessary precautions. The following are of the first importance:

1. *Keep the microtome perfectly clean.* To accomplish this, not only must all dust be removed, but also no oil which has become thick or gummy must be allowed to remain. A special risk comes from the paraffine, small bits of which are very apt to fall upon the instrument, and if they are permitted to lodge on any of the movable parts they may easily cause serious injury and will certainly prevent even section-cutting. Extreme cleanliness is indispensable, and to better secure it the microtome should always be covered when not in actual use.

2. *Keep the microtome perfectly oiled.* All the movable parts must be well lubricated

with clean, fresh oil. The micrometer screw should be oiled with porpoise oil, which will last for months. For the other parts a light paraffine oil may be used. I have found that which is known to the trade as No. 40 suitable.

3. *All the permanent adjustments must be perfectly set.* Of the permanent adjustments there are two which require more or less constant attention: *First*, the movable gib, by which the carriage is held against the vertical way; that gib should fit as tightly against the way as is compatible with the free running of the apparatus. If this is not done no satisfactory sections can be obtained, because the action will be irregular. *Second*, the split-ring around the neck of micrometer screw must be tightened sufficiently to prevent any back-lash, but not enough to make the screw hard to turn.

4. *All the changeable adjustments must be absolutely firm.* In order to attach the paraffine plate to the movable carriage there is a triple clamp, so constructed as to allow independent movements in three directions. The three screws of the clamp must all be tightened, and novices must remember that a metal screw cannot be tightened with the first turn, but that after a minute or so it can be tightened a little more. The knife is held by two screws, which must also be doubly tightened to ensure the knife being firmly held. In my experience with students, it seems to me that about nine-tenths of the failures to get satisfactory sections are owing to the neglect of the proper clamping either of the knife or the object-holder, or both.

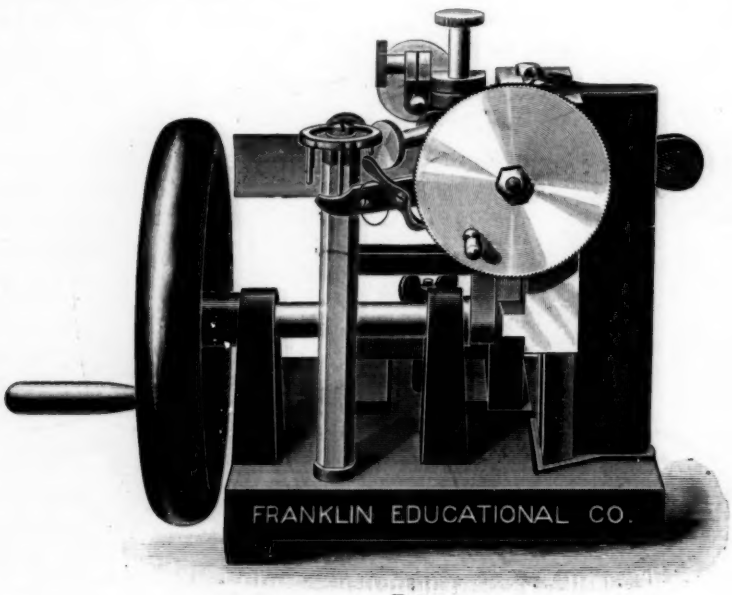

Fig. 2.

5. *Avoid cutting on days when the sections become highly electrified.* Everyone who has done much section cutting of objects imbedded in paraffine has encountered the difficulty of handling sections which have been electrified during the cutting, for the

sections will then jump at any neighboring object, especially of metal, and adhere to it obstinately. Sometimes the force is sufficient to break a ribbon of sections, which will then snap at the microtome and in an instant be clinging to it in a hopeless snarl. The amount of electrification varies from day to day, and there are fortunately days during which the phenomenon is absent. Usually damp days are the best. The cutting of any valuable object should be reserved for one of the favorable days. By laying an inclined plane, some ten inches long, of wood or cardboard, with its upper edge under the knife and its lower edge resting on the table, it will be found that the ribbon of sections, even if electrified, can be handled with comparative safety, for, even if the sections are drawn down by the electrical attraction, they will lodge upon the plane and usually will become either twisted or entangled.

II. THE PRECISION MICROTOME.*

The first object of a microtome is to make sections of even and known thickness; the second object is to make a sections in large numbers of uniform thickness; the third object is to make sections rapidly. Finally, in recent years, there has been a growing and justified demand for microtomes to make good sections of extreme thinness, if possible not over one five-hundredth of a millimeter or two microns (0.002 mm.). Sections of such tenuity and even possibly of less thickness have been made hitherto with the microtomes now in use, and I have not infrequently encountered the statement that the requisite precision was already secured by one or another pattern of microtome. In looking at such sections I have observed in a number of cases that they were much thicker than they were stated to be, and have learned upon inquiry that the scale of the microtome was unknown to the operator. In other cases the sections appeared to be really as thin as stated, but such as I have seen were invariably of minute objects, which offered no real difficulty to fine sectioning. I do not think any form of microtome hitherto constructed can be relied upon to yield sections 0.002 mm. thick of objects that are of even moderate size or that offer much resistance.

The first step was to gain a more definite notion of the practical hints of admissible error. Now, upon trial it was found that sections which vary more than one-tenth from their supposed thickness can, in the case of stained animal (vertebrate) tissues, be readily recognized by the naked eye as uneven. Hence, it is obvious that the thinner the section the less must be the amount of absolute error in the cutting. For example, an error of 0.0002 mm. is the maximum admissible for sections of 0.002 mm. (500 to a millimeter), though a much greater error would not be noticeable in sections of 0.02 mm. Applied to the microtome this means that a roughly made instrument is sufficient for thick sections, but the most perfect construction is necessary to secure a microtome for fine cutting. Besides, for greater mechanical perfection, a new microtome should also strive to be so constructed as to be suitable for both dry (paraffne) and wet (celloidine) cutting.

It seemed to me that progress might be made on the basis of the following principles:

First: The object should be supported directly under the knife, and upon a carriage with a broad base.

Second: The carriage should move upon a horizontal way below the knife.

Third: The object should be fed to the knife by a vertical micrometer screw, which should be arranged to work automatically.

Fourth: The knife should be firmly

*This instrument has been shown at Paris, Liverpool and before the Society of Morphologists at Boston. See Comptes Rendus Soc. Biologie, Paris, 1896, Juin, p. Report British Assoc. Adv. Sci., Liverpool, 1897, p. 979. SCIENCE, N. S., Vol. V., p. 106.

clamped at both ends upon a rigid frame, the frame to be made square so as to allow the knife to be placed in any desired position or at any desired angle.

Fifth: A cup, with a drainage tube, to be placed under the object-holder to collect alcohol and prevent its falling, while the apparatus was in use for wet-cutting, upon the gears or ways beneath.

About two years ago I consulted with Mr. Edward Bausch in regard to the projected microtome, and we have worked in collaboration to solve the many problems involved in the practical application of the five principles enumerated. It is a pleasure to state that Mr. Bausch has contributed in many and in essential ways to the plan of the microtome, and its successful production is largely due to his zealous interest. He has certainly spared neither time nor pains to secure a good result.

In designing the new microtome precision was made the prime object. The usual sources of error are: (1) in the bending of the knife; (2) the yielding of the object to be cut, chiefly because it is at the end of an arm which acts as a lever; (3) the 'jumping' of the sliding gear. All these defects are at their maximum in the Rivet type of microtome, of which the best known form is the Heidelberg or Thoma-Jung. It is believed that in the new microtome these three sources of error are materially diminished.

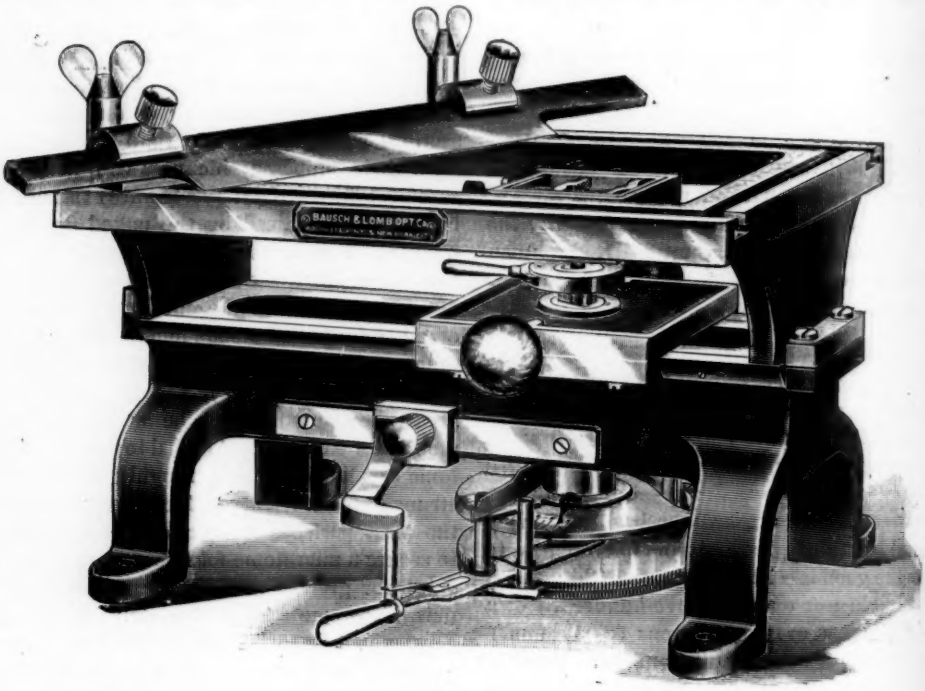

Fig. 3.

The accompanying illustration, Fig. 3, affords a general view of the Precision Microtome. The uppermost part of the microtome is a square frame heavily made

of cast iron. The knife is held by two clamps, which can be fastened at any point in the slots upon the upper part of the square frame, so that the knife may be either at right angles or at any desired inclination to the direction of the draw in cutting. As the knife blade is thick and strong, and is clamped at both ends, the cutting edge is rendered almost immovable. Underneath the knife-bearing frame are the two horizontal ways, upon which runs the sliding carriage. It will be noticed that the general construction of the whole machine resembles in principle a lathe-bank. The carriage itself is a broad platform with a raised rim; by its size the danger of tilting in any direction is rendered small; between the two horizontal ways. At the bottom of the screw there is a large toothed-wheel, which is utilized to feed the screw automatically. The toothed-wheel is turned either to the right or left, as desired, by means of the lever, the long handle of which is seen projecting at the bottom of the figure. The figure also shows the lever resting against a vertical bar. When the carriage is moved the micrometer attachment and the lever are moved along with it, and when the lever strikes against the vertical bar it is forced to turn the toothed-wheel and so work the feed of the apparatus. It will be noticed that the vertical bar is borne upon an arm, which can be slid to and fro upon the body of the microtome

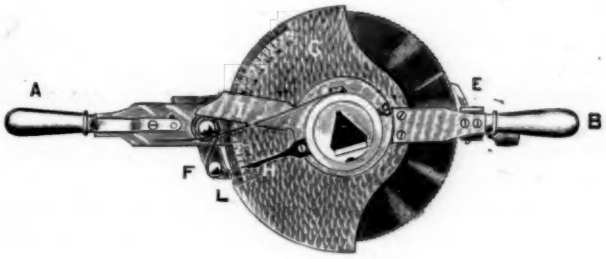

FIG. 4.

the raised rim serves to retain the alcohol, which drips from the specimen above and prevents its falling upon any of the working gear; from the surface of the carriage the alcohol is drained off by a tube, which, being upon the further side of the instrument, is not shown in the engraving. The object-holder is a square box, and is so devised that it can be readily lowered or raised, and renders it easy to adjust the plane of the section after the object has been clamped in. As the object-holder is supported firmly immediately under its own center, the possible leverage is minimized. The object is raised by a micrometer screw, which works with a vertical tube which descends from the middle of the carriage and clamped at any point as wished. By these means the lever can be set in action at any desired point of the excursion of the movable carriage.

The arrangement for the automatic feed is similar to that employed in de Groote's microtome. As modified for the needs of the 'Precision Microtome,' the device seems to me to leave little to be desired on the score of either convenience or accuracy. Figure 4 gives the plan of the arrangement. The following description of the feed was drawn up by Mr. Bausch:

"The feed arrangement consists of a micrometer screw, having pitch of 0.5 mm., which elevates the object-holder.

"The motion of the screw is transmitted

to the object-holder through a triangular bar, moving smoothly but firmly in a triangular channel, all lateral motion being eliminated by means of a wedge.

"The construction of this part is exactly the same as that used in the fine adjustment of the microscope. (The triangular bar, wedge and bearing are shown in section in the figure.)

"The micrometer screw is provided at its lower extremity with two metal discs in contact, each having one hundred serrations, the acute angles of the upper disc pointing to the right, and those of the lower to the left. The discs are revolved by means of the lever A, which is pivoted loosely on the axis of the micrometer screw, and which is provided with a pawl, F. F is actuated by the small lever shown on the upper surface of A, so that when the actuating lever is thown to the left, F engaged the teeth of the upper disc, and motion of A to the right elevates the object. The spring rachet, E, prevents any backward motion of the screw head and may be disengaged by means of the thumb screw shown.

"After the screw has been fed up to its greatest extent it is quickly returned by moving the actuating lever to the right, when a small pawl, not shown in the figure because beneath the lever, engages the teeth of the lower disc, and motion of A to the left depresses the object carrier. The *amount* of elevation of the object is concontrolled in an entirely automatic manner.

"The stop I is a rigid attachment and is provided with an index, H. C is a graduated disc pivoted around the axis of the feed and movable by means of the lever, B. Two graduations on C correspond to one of the notches on the disc of the micrometer screw.

"Beginning at zero of the scale, the circumference of C has an inclined plane for the following purpose:

"The disc C being set so that the number indicating the desired thickness of section is opposite the index, the stop post of A is held against the stationary stop, I, by the long spring; F engages a tooth of the upper disc. If now the lever A is moved to the right, F will continue to engage the tooth of the disc until the guide post, L, comes in contact with the inclined plane on the margin of C, which disengages the pawl, F, from the tooth of the disc exactly at the zero point of the scale. It will thus be seen that no matter how far A may be moved, F will act only through a certain prescribed distance, governed by the position of the disc C, and that the amount of elevation of the object is definitely indicated by the position of H on the scale.

"The operation of the feed arrangement may be made either automatically or by a separate movement of A by the hand; the former for serial and ordinary sectioning; the latter for very thick sections or for sections of irregular thickness.

"If automatic feed is desired, the sliding stop on the base of the microtome frame (see figure) is adjusted to act as a stop for A, carrying it through the required arc, when the sliding carriage is moved forward and backward for cutting the section.

"When the hand feed is used, the adjustable stop may be slid back out of the way, or removed from the instrument altogether.

"The advantages of this feed may be summed up, as follows:

"Simplicity.

"Great accuracy.

"Short feed (distance object is elevated by movement of one tooth of the disc, being 2 microns).

"The feed entirely independent of amount of motion given to feed lever, A.

"Convenience of setting for any desired thickness.

"Automatic or hand feed at will.

"Object elevated when object carrier is

being returned to position to begin cutting and after the object has passed under the knife.

"Ease with which feed screw may be returned when fed up to its full limit."

III. A NEW FORM OF MICROTOME KNIFE.

To satisfactorily sharpen a knife for fine section-cutting is a diffiulty, which we all have learned to estimate as serious. The valuable article by Moll on sharpening in the *Zeitschrift für Wissenschaftliche Mikroskopie* in 1892 (Bd. IX, p. 455) called my attention to various possibilities, and at my request Dr. F. S. DeLue tested a number of methods. These tests resulted in the adoption of plate glass and diamontine powder mixed with water as the best means of securing a satisfactory cutting edge. Plate glass seems to have been used from time to time, and is especially recommended by Moll. The use of diamontine powder was suggested by Dr. Lotze (Johns Hopkins Hospital Bull., Dec., 1894).

FIG. 5.

Having at command a satisfactory method of sharpening, it soon became evident that the knives should have a form to which that method could be applied conveniently. It was necessary that the knife should be: 1, rigid; 2, slightly hollowed on both sides; 3, of such shape that it could rest its whole length on a plane surface; 4, that there should be no edge to be sharpened, except such as could be used for actual cutting. These four requirements are met by the pattern illustrated in Fig. 5, already made in two sizes, the larger being intended for the '*Precision*,' the smaller for the '*Automatic wheel*' microtome. In both knives the essential features are the same, the proportions only being different. The larger knife is 330 mm. long; its cutting edge is 185 mm. long, and it is 12 mm. thick at the back. The smaller knife is 160 mm. long; its cutting edge 85 mm. long, and it is 10 mm. thick at the back. These knives have the handles of the same cross section as the blade; they are alike on both sides, being slightly concaved. A knife of this pattern can be laid upon a glass plate, upon which a little water with diamontine has been rubbed; the knife rests upon its cutting edge and upon its back edge, and may be perfectly sharpened without any special technical skill by simply passing the blade to and fro, resting alternately first on one side, then on the other, until the entire edge is completely polished.

The knife is then removed, thoroughly cleaned, the glass plate also cleaned and the edge finished by polishing on the glass plate with water only. The glass plate by itself will remove any wire edge which may be left by the diamontine powder.

It often requires considerable time to get the first edge on a new knife, for the knives as furnished by the manufacturers are never quite straight, but after the edge has been once obtained it is easily kept in condition, provided that it is not allowed to become nicked or dented through careless handling.

There is one precaution in the use of this method of sharpening which cannot be taken too conscientiously, namely, to keep the glass plate while in use absolutely free from dust and dirt of every description;

the glass itself must be kept absolutely clean, only *filtered* water to be put upon it, and the diamontine must invariably be protected from the dust.

A knife is sharpened when its edge appears smooth and straight under a magnifying power of 40–50 diameters.

When section cutting began a razor was the sharpest of familiar tools, and so it happened that for years razors were used not only for free-hand cutting, but also for microtomes. When knives began to be made specially for microtomes the razor type of thin blade was followed. We now know that the razor is the worst possible model for a microtome knife and that the chisel pattern is infinitely superior, because a thin blade is elastic, while a thick blade is rigid. With small objects or soft tissues the resistance may be so slight that the razor will cut them satisfactorily. Or, again, if the sections are thick the error of the razor may be unimportant, but for very thin sections, or for cutting difficult objects, the new heavy type of knife may fairly be said to be indispensable.

Charles Sedgwick Minot.

Harvard Medical School.

XII. DEUTSCHER GEOGRAPHENTAG, JENA, 1897.

During the late Easter vacation there were gathered together, in the charming little university town of Jena, a large number of the German Scientists whose work touches more or less closely the field of geography. When one considers the variety of subjects represented he must put the question: What is Geography?—What has it been in the past and to what future fields is the present aspect of the science leading. To consider this theme, at length, is not the intention of the writer in giving a short account of this Congress of German Geographers, but he would like to use this question as a connecting thread in the following lines.

There were nearly 600 members and associates in attendance, making this Geographentag the third largest in numbers of this series of most successful gatherings. Only Berlin and Vienna have had a larger attendance, and so it was said that Jena should be rated as a city with a million inhabitants. All those present were not from Germany, as eleven other nationalities were represented, these justly famous scientific gatherings naturally attracting foreigners. The addresses given are of such merit and given by such men as to induce many to come to hear, but it is not forgotten by the committees in charge that the most important feature of such gatherings is to bring the workers in various fields together, and to give them opportunities for conversation and consultation. The four and a half days were very happily arranged so as to supply a combination of attractions suited to the wants of all.

Under the presidency of Geheimrath Neumayer the members were led to consider the investigation of the region of the South Pole, and were shown that while very little in the way of actual exploration had been done by the commission, which was appointed at the XI Deutschen Geographentag in Bremen, still a large amount of material had been collected, and the way was being prepared for pioneer work in this little mapped region. Outline cartography, or the separation of land from water areas, is one of the early stages of geographic science. It is naturally followed by expeditions over land in the less known portions of the continents. This second phase of the science was represented at Jena by the three following papers: Expedition to Central Brazil, by Dr. Herrmann Meyer, of Leipzig; German Investigations in Asia Minor, by Dr. Heinrich Zimmerer, of München; Journey through Syria and Ana-

toila in 1895, by Roman Oberhummer, of München. Many interesting items of geographic news were brought back by these travelers, but they will not be enumerated here, for this sketch cannot go into many details. Let us, therefore, note the methods of the present explorations as contrasted with those of the past. When there were extensive areas of unexplored territory it was most inviting for an ambitious man to attempt to cover as much area as possible. How thin a covering of the ground was made by these early travelers is well known by any one who has tried to find out some particular thing from the accounts of their journeys. The modern traveler must study in more detail a given area of smaller dimensions, or take up some special problem in a larger area. An example is seen in the minute ethnographic studies made by Dr. Meyer in the interior of Brazil.

In America one is apt to look upon the work of the schools in Prussia as so far ahead of American schools in methods of teaching geography as to be almost a model to be followed; but the exceedingly suggestive paper of Oberlehrer Fischer, of Berlin, made his audience feel that there was much cause for instant improvement in the work of the teachers of geography in Prussia. The very valuable statistical tables presented by Mr. Fischer will shortly be published in a separate pamphlet with the text. Professor Dr. W. Sievers outlined a plan of extended excursions with students to teach them geography by a closer examination of typical forms in various regions. For the universities of middle Germany he suggested three trips in successive years, one to the coast, the second to the highland, and the third to the Alps. Professor Dr. J. Palacky, of Prag, spoke of the importance of an herbarium arranged according to geographical distribution of plants for the teaching of geographic botany.

One morning was given up to the discussion of the Geophysical problems of earthquakes and magnetism. Professors Gerland, of Strassburg, and Supan, of Gotha, led the former, and Drs. Ad. Schmidt, of Gotha, and E. Naumann, of München, the latter. Many others took part in the discussion. Professor Supan outlined a plan for the more systematic observation and recording of the local and more widespread earthquakes. Governmental aid is to be asked in the carrying out of some such plan. These problems bordering upon physics and geology would hardly be considered geographic in America. As one man expressed it at Jena, "The subjects of earthquakes and magnetism are considered under geography in Germany only because they belong nowhere else." Many other subjects from various sciences may be made geographic by considering them in relation to their distribution over the earth.

There were three papers in the field of biologic geography: 'Australian Fauna,' by Professor Dr. Semon, of Jena; 'The distribution of the various animals used in transportation and their dependence upon geographic conditions,' by Dr. Ed. Hahn, of Lübeck; 'The animals upon the island Borkam, particularly in regard to important observations for the geographic distribution of animals,' by Professor Dr. O. Schneider, of Dresden. Professor Semon presented tables showing the proportions of species living only in Australia and those living also in other neighboring lands. Dr. Hahn made a most interesting presentation of the marked geographic control shown in the distribution of the various beasts of burden in use in different parts of the world. Professor Schneider pointed out the importance of making a thorough study of the species inhabiting the Frisian islands belonging to Germany, before the same are connected with the mainland artificially, as is contemplated by the government.

Professsr Dr. J. Walther gave the only physiographic paper of the week. He described in most picturesque language the present forms of the Thüringer *horst*, and showed how much more the form of this elevated block, or *horst*, of the Thüringer Wald, is dependent upon the series of northwest-southeast faults of late Tertiary to recent time than upon the system of the eastnortheast-westsouthwest folds of Carboniferous time. Where, however, these planed folds of the Erzinian system are resurrected by the stripping off of the Mesozoic strata the forms are in great measure controlled by the earlier made folds, as, for example, in the Cambrian ridge, Lange Berg.

Mathematical geography was also represented by one paper: 'The shadow cast by mountains and its effect in the Alps and in the mountains of middle Europe,' by Dr. K. Peucker, of Vienna. The mathematical calculations were too intricate for the audience to follow, but the graphic diagrams, illustrating the effects of varying trends and elevations in different sections, were followed attentively. One of the excursions was to the immense plant for the manufacture of optical instruments belonging to Carl Zeiss, where applied mathematics is used to the great advancement of science. The various delicate processes connected with the grinding and polishing of the many forms of lenses, as well as the forging and cutting of the metal portions of the instruments, were all shown and explained. The new tele-objectives for photographing at a distance or in places difficult of approach were examined, and the wonderful details seen in photographs made several kilometers distant were duly admired. The opera glasses with long tubes, capable of being extended in any direction in a plane at right angles to the line of sight, will no doubt be highly appreciated in the United States, where theater hats are not as yet out of date.

The longest excursion of the week was made to Weimar, where a special performance for the benefit of the members of the Geographentag was given in the theater, which is under the patronage of the Grossherzog and is closely associated with the lives of Goethe and Schiller. The points of historical interest in Weimar were opened to the guests in the same way that they had been in Jena. Among the other excursions were those to the battle field of Jena, to the Ilm graben, to the Saale valley, to the glass works, as well as visits to the collections in the university, the specimens brought from various deserts by Professor Walther, the zoological and other University departments. Walking parties in the beautiful suburbs of Jena and some social gathering every evening brought the workers in geography into closer touch with one another. Geographers as well as other men in Germany are particularly social and companionable after saying 'prosit' over their beer.

Geography in Germany attracts men. The average attendance at the monthly meetings of the Gesellschaft für Erdkunde in Berlin is 400–600. The study of the earth in its relation to man should attract men; nothing could be more natural. As a science, geography should be made more systematic; scientific, but clear and simple so that children may understand; comprehensive, since man is so many-sided; and yet trimmed of all irrelevant matter. Let us strive toward a high-ideal development of geography in America.

F. P. Gulliver.
Geographisches Institut, Wien.

STATUS OF FOREST RESERVATION POLICY.

By the vote of the Senate, on May 27th, adopting the conference report on the Sundry Civil Appropriation Bill, the United States government took one more forward step in establishing a forest policy; the

adoption of the report by the House of Representatives and the signing of the bill by the President being a foregone conclusion. That bill contains an amendment (based upon the so-called McRae Bill, the measure advocated by the American Forestry Assocation) under which the Secretary of the Interior is authorized to institute a forestry service for the forest reservations which had been established prior to the late proclamations by President Cleveland and such as may be made hereafter. These latter reservations, made upon the recommendation of the Committee of the National Academy of Sciences, have by this amendment been suspended, *i. e.*, the operation of the proclamations has been annulled until March 1, 1898, and until that time the lands embraced in these reservations are to be returned to the public lands open to entry and subject to the general land laws.

A survey of all the reservations, showing the distribution of the forests, by the Geological Survey is ordered and an appropriation of $150,000 made for it, the supposition being, although not definitely expressed in the bill, that such surveys or sufficient portions of them can be accomplished before March 1, 1898, and give information as to existing conditions which will enable the President to entirely revoke or else intelligently modify the boundaries and extent of the reservations, power to do so being expressly given in the bill.

This entire legislation is, to be sure, a compromise measure and extremely crude and imperfect, having been precipitated by the strenuous opposition of the Western delegates to the reservations made by Mr. Cleveland's order. These, it is claimed, have been established hastily, without sufficient knowledge and discrimination, without opportunity for interested parties to be heard, embodying, at least in some cases, large areas that should not reasonably have been included. To the last the Western representatives acted as a unit in discrediting in every way the hasty action of President Cleveland and his advisors, and in insisting that the proclamations be unconditionally and forever annulled.

In spite of the crudities and the emasculated condition of the legislation which finally saved the reservation policy and secures the first beginnings of a forestry service, it must be welcomed as such a first step, which may gradually be developed into a creditable forest administration. Thus, while it appeared a misfortune that the Committee of the National Academy advocated the extension of forest reservations before having submitted their report on the necessary administration of the same, it may have proved a blessing in disguise.

There is no specific appropriation with which to inaugurate the forestry service, unless the $90,000 appropriated for Special Timber Agents is construed to be applicable.

The manner in which the Geological Survey will acquit itself of its difficult task of segregating the lands which are properly to be reserved or excluded from reservations which will have to do with allaying the opposition of the Western States and forwarding the establishment of a sound forest policy.

B. E. FERNOW.

CURRENT NOTES ON PHYSIOGRAPHY.

TOPOGRAPHICAL MAPS OF THE GEOLOGICAL SURVEY.

BY recent Congressional enactment, the topographic as well as the geologic maps and atlases of the U. S. Geological Survey may be sold to the public. Heretofore the distribution of the topographic sheets has been somewhat irregular; and, although a few years ago the statement was authorized that copies of the maps would be distributed to schools for use in teaching geography

as long as the printed editions lasted, this proved an insufficient means of placing them in the hands of the public. They are now sold at five cents apiece for small orders, or at two cents each in orders of a hundred sheets or more, whether for the same or for different sheets. Two dollars for a hundred maps is certainly a merely nominal price. Nine hundred sheets have been printed. Lists of the maps may be had on application to the Director of the Survey. Orders for sheets must be accompanied by money order or cash for the exact sum called for.

Among the newer sheets may be mentioned Lexington and Stromsburg, Nebraska, including parts of Platte river sprawling on in tangled channels its sandy bed, with dissected uplands on either side of its broad valley floor; Pasadena, Cal., showing what appears to be a great alluvial fan spreading out from the base of the San Gabriel mountains; Chester, Pa., with a number of sub-parallel, transverse streams draining the 'stripped belt' of old-land marginal to the New Jersey coastal plain, as if they had been set on the old-land rocks by superposition when the plain stretched further inland. Many others are of equal interest. The San Mateo, Cal., sheet (part of the San Francisco peninsula) is notable for the delicacy of its contour lines, which appear to show much more detail than usual and in this respect stand in strong contrast with the free-hand contours on the earlier Fort McKavett, Texas, sheet. The same is true of the contrast between the irregular contours on the Pueblo, Col., sheet, edition of 1896, and the over-generalized contours of the same sheet, edition of 1891.

THE BARABOO DISTRICT, WISCONSIN.

"The drift phenomena in the vicinity of Devil's Lake and Baraboo, Wisconsin," (*Chicago Journ. Geol.*, V., 1897, 130–147) is a paper based on field work by students of the University of Chicago, under the direction of Professor Salisbury. The region is one of varied attractions, including the Baraboo ridge, an ancient quartzite monadnock on the peneplain of pre-Cambrian North America, submerged and buried in early paleozoic sediments, now exposed again by weathering and denudation, and thus, like other ancient fossil forms, organic or inorganic, presented to us for study. The ridge is irregularly traversed by the terminal moraine of the Green Bay glacial lobe, and the irregular path of the limiting drift ridge is the subject of special study. Devil's Lake lies in a deep gorge, excavated in preglacial time (probably for the most part, Tertiary) across the quartzite ridge; the agent of excavation being apparently the Wisconsin River, now displaced by heavy moraines in the gorge. The quartzite ridge was somewhat sculptured in pre-Cambrian times, for its slopes still hold a sandstone filling in ancient ravines; but we question whether the gorge was so largely of ancient origin as is implied (p. 141). The greater part of its walls are free from sandstone; and, moreover, it would be altogether unlikely that an ancient gorge, refilled during burial, should have been again discovered and occupied by a superposed river.

BALCH, ON ICE CAVES.

E. S. Balch, lately President of the Geographical Society of Philadelphia, has for some years made a special study of ice caves, and now presents a summary of his observations and researches (Ice caves and the causes of subterranean ice, Journ. Franklin Inst., Philadelphia, March, 1897). The popular belief that ice forms in these caves only in summer is combatted. This idea seems to be based on the fact that in summer the air of a cave feels cool, while in winter it feels warm; but this is only by

way of contrast with the external air, and not at all indicative of actual temperatures. Caves are coldest in winter, but if no water then enters, the formation of ice is delayed until milder weather outside thaws the surface ice or snow. The fact that ice caves are unknown in regions where the ordinary winter temperatures is not below freezing is taken to prove that their true cause is the most manifest one, and that the ice is not due to reduction of temperature by evaporation, and especially that it has nothing whatever to do with a lingering of the glacial period underground. Further details are promised in a later publication.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

ETHNOGRAPHY OF MADAGASCAR.

Two interesting articles on the above subject may be compared, with special reference to the ethnic position of the Hovas.

The one is by Mr. W. L. H. Duckworth and appears in the *Journal Anthropological Institute*, February, 1897, on some skulls from Madagascar in the Museum of Cambridge University. His conclusion from his very careful measurements is that the Hova skull finds its counterpart in the Borneo, therefore Malay type, while those from the Betsileo and Betsimisaraka tribes have marked African traits.

This is in accordance with the general opinion that the Hovas are of Malayan origin. Yet Professor Letourneau, in the Bulletin of the Paris Anthropological Society, throws overboard all the evidence, linguistic and physical, which attaches the Hovas to the Malayan stock, and claims them as purely African, along with the other natives of the island. His arguments are too hasty to carry conviction, and it cannot be said that he has seriously shaken the prevailing opinion.

STUDIES IN MAYAN HIEROGLYPHS.

Two short but valuable articles have recently been published by Dr. Förstemann; the one, the sixth number of his series 'Zur Entzifferung der Mayahandschriften;' the other a paper in *Globus*, Bd. LXXI., No. 5. The latter takes up eight glyphs, and sets forth their relations in the Dresden Codex, and suggests what they mean, or, what they *cannot* mean, for the logical process of exclusion is here of great use.

In the former article he examines the passage of the Dresden Codex which covers the upper thirds of pages 31 and 32. There is evidence, which he mentions, that to the writer of the Codex this was an important paragraph. It deals with large numbers, and not with past or present, but future time. It can, therefore, be nothing else than a prophecy or forecast. What was connected with such a calculation can now be only surmised, as this portion of the literature was transmitted orally. Incidentally (p. 4) it is shown that the calculations of the Dresden Codex date from an epoch anterior to those found on the latest sculptures of Copan.

PSYCHICS IN THE STUDY OF MAN.

NOTHING could be more proper than to include in an anthropological library the 'Proceedings of the Society for Psychical Research,' although it has a queer repute for ghost hunting, etc. The address of its President, William Crookes, F.R.S., is a pamphlet well worth reading and thinking about by the most physical anthropologist. It is a study of the effects of environment on man, considering how the world would look to him if he was the size of a mite, or, on the other hand, as tall as a tree; how he could be influenced by an increase or decrease in the power of gravity, and what might happen to him if he could manage to perceive the millions of vibrations which

now pass through him without his knowing anything about them.

Such studies ought, indeed, to be the foundation of the science of man, involving, as they do, the recognition of his limitations and also his incalculable capacities. It is foolish for scientific men to reject or neglect them on the ground that they are 'visionary' or 'spiritualistic.' What we want is to pursue knowledge in every direction, and to its limits, if we can.

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

In many of the acids, especially of the less strongly negative elements, the oxygen may be replaced in whole or in part by fluorin, a pair of fluorin atoms taking the place of each oxygen atom. This is true of the borates in the third group, all the acids of the fourth group except the carbonates, the vanadinates, columbates, tantalates, arsenates and antimonates in the fifth group, the chromates, molybdates, tungstates and uranates in the sixth. Attempts have been made by Weinland and Lauenstein to enlarge this list and their results are given in a recent *Berichte*.

By the action of hydrofluoric acid on the iodates, difluoriodates were formed, of the formula KIO_2F_2, $NaIO_2F_2$ and $NH_4IO_2F_2$. These salts are comparatively stable when dry, but are decomposed readily by moisture. Efforts to form fluo-periodates, fluo-manganates and fluo-tellurates have thus far been unsuccessful.

The ordinary cadmium sulfate crystallizes with 8/3 H_2O, while the sulfates of magnesium, zinc, iron, nickel, cobalt and manganese contain seven molecules of water of crystallization. Cadmium sulfate, however, forms double sulfates isomorphous with the double sulfates of the others. Mylius and Funk have just succeeded in obtaining a cadmium sulfate with the normal amount of water. A solution of the salt, saturated at 70° is suddenly cooled to —20°, and by agitation a cryohydrate crystallizes out. When the temperature is then allowed to slowly rise, the cryohydrate melts, but leaves a granular deposit of crystals sometimes several millimeters in length, of $CdSO_4$, $7H_2O$, cadmium-vitriol. The crystals are, however, very unstable.

The same *Berichte* contains two additional papers by Professor Söderbaum, of Gothenburg, on the acetylid of copper. It was recently mentioned in this column that he had formed a complex compound by the action of acetylene on an ammoniacal solution of copper sulfate. He now shows that by carrying on the action in quite dilute solutions in the cold, the precipitate contains two atoms of carbon for every atom of copper, and he takes as its formula $C_{24}Cu_{12}$, H_2O. The substance is similar to the one formerly described as obtained in a hot solution, but is rather more explosive, and the humus-like compound formed by its treatment with acids is richer in carbon. Professor Söderbaum proposes this method for the quantitative estimation of copper, as well as its quantitative separation from zinc.

A new element, Bythium, is announced in the *Electrochemische Zeitschrift* by Theodor Gross. A fused mixture of silver sulfid and silver chlorid is electrolyzed in a nitrogen atmosphere, using platinum electrodes free from iridium. In the melt is found a dark gray powder, insoluble in aqua regia and in ammonia. Fused with alkaline carbonate it gives a melt soluble in hydrochloric acid, from which hydrogen sulfid gives a brown precipitate. The yield of the new substance is 5% of the original sulfur used. From the fact that there is a corresponding loss of sulfur, the author considers that this bythium is formed by the decomposition of sulfur, though he admits that since there is a small (3%) loss of chlorin

in the electrolytic reaction, it is possible that bythium may be formed by the decomposition of chlorin. An atomic weight determination will be looked for with interest.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE committee on international mails of the postal congress has decided that natural history specimens and articles for scientific collections be admitted to the mails as samples. This will permit of their being sent at the rate of one cent for every two ounces, whereas at present it is necessary to pay five cents for each half ounce or fraction thereof. It will be remembered that this amendment to the regulations of the Universal Postal Union was proposed at the Leiden meeting of the International Zoological Congress at the instance of Dr. Charles Wardell Stiles, and its adoption has been urged by many men of science and scientific associations.

IN the House of Commons, on May 27th, the President of the Board of Trade, Mr. C. P. Ritchie, introduced a bill to legalize the metric system of weights and measures.

Two fine specimens, male and female, of the rare West Indian seal (*Monachus tropicalis*, Gray) have been received at the National Zoological Park. They were captured on the 11th of May on Campeche Bank, southern part of the Gulf of Mexico.

ON the occasion of a recent excursion of the geology classes of the University of Alabama, in charge of Professor Eugene A. Smith, the public spirit and liberality which are characteristic of the authorities of the Louisville and Nashville Railroad, were exemplified in placing at the disposal of the class a special train, by means of which the boys were enabled to visit all the mines, quarries and other places of interest along the mineral branch of this great system.

THE will of the late Judge John Lowell, of Newton, Mass., gives $3,000 to the American Academy of Arts and Sciences.

IT is reported that some of the heirs at law are contesting the will of the late Alfred Nobel, and that this will delay the distribution of the great prizes established by him.

BY the will of the late Charles F. Lawrence the town of Pepperell, Mass., receives $100,000 for the establishment of a library and art gallery.

THE Council of the Royal Society has recommended for election the following fifteen candidates: Dr. Robert Bell, Assistant Director of the Geological Survey of Canada; Sir William Broadbent, a London physician and neurologist; Dr. Charles Chree, Superintendent of the Kew Observatory; Mr. H. J. Elwes, known for his contributions to ornithology and entomology; Dr. J. S. Haldane, lecturer in physiology at Oxford; Dr. W. A. Haswell, professor of zoology in the University of Sydney; Mr. G. B. Howes, professor of zoology in the Royal College of Science, London; Dr. F. S. Kipping, known for his researches in chemistry; Mr. G. P. Mathews, professor of mathematics in the University College of North Wales; Mr. G. R. M. Murray, the botanist; Mr. F. H. Neville, the physicist; Dr. H. A. Nicholson, professor of natural history in the University of Aberdeen; Mr. J. M. Thomson, professor of chemistry in King's College; Mr. F. T. Tranten, the physicist, and Mr. H. H. Turner, professor of astronomy at Oxford.

THE American Philosophical Society, of Philadelphia, has elected the following foreign members: Lord Lister; Professor H. C. Röntgen, Würzburg; Dr. Fridtjof Nansen; Professor Theodor Tschernyschew, of the Geological Survey of Russia, and Professor A. Karpinski, Director of the Geological Survey of Russia.

DR. A. FISCHER VON WALDHEIM, professor of botany in the University of Warsaw, has been appointed Director of the Botanical Gardens of St. Petersburg.

IT is proposed to erect a monument to the late Professor Anatole Bogdanov, the eminent Russian anthropologist and naturalist, and at the same time to endow a prize for scientific work in Moscow University to bear his name.

AT the annual meeting of the Brooklyn Institute on May 28th Professor Shaler, of Harvard University, made an address in memory of Agassiz.

Professor Josiah Royce, of Harvard University, has been invited to deliver next year the Gifford Lectures at the University of Aberdeen.

M. Souillart, of the University of Lille, has been elected a correspondent in the section of astronomy of the Paris Academy in the place of Dr. Gyldén.

The *Botanical Gazette* states that the Royal Swedish College of Agriculture has conferred a gold medal on Professor Jakob Eriksson in recognition of his studies of the life histories of grain rusts.

Dr. Franz Boas, of the American Museum of Natural History and Columbia University; Mr. Harlan I. Smith, of the Museum of Natural History, and Dr. Livingston Farrand, Columbia University, have left New York for an expedition to the North Pacific coast, the expense of which has been provided for by Mr. Morris K. Jessup and which was fully described in the issue of Science for March 19th.

Nature states that Mr. R. C. L. Perkins, of Jesus College, Oxford, who has been for several years engaged on behalf of the joint committee appointed by the Royal Society and the British Association in studying the zoology of the Sandwich Islands has now returned to England.

At the annual meeting of the New York Electrical Society on May 20th Professor M. I. Pupin was elected President and Mr. George H. Guy, Secretary. There are now 397 members of the Society.

The Russian National Health Society proposes to celebrate next year the 100th anniversary of the discovery of the mineral springs of the Caucasus by a conference on balneology and climatology.

The 66th annual fair of the American Institute will open in Madison Square Garden on September 20th, and will continue for six weeks. Efforts will be made to secure the adequate representation of improvements in machinery made during the past year.

The American Public Health Society will hold its twenty-fifth annual meeting at Philadelphia from the 26th to the 29th of October. Nineteen subjects have been suggested by the executive committee for special discussion.

The American Academy of Medicine held its 22d annual meeting at Philadelphia, on Saturday and Monday, May 29th and 31st. The proceedings included a discussion on the relation of the College to the medical school, in which the Medical School was represented by Dr. Bayard Holmes, of the College of Physicians and Surgeons, of Chicago; the College, by President Warfield, of Lafayette College, and the University by Dr. William Pepper, lately provost of the University of Pennsylvania.

The fourth meeting of the International Congress of Technical Education will be held in London, beginning June 15th.

We have received the first two numbers of a *Natural Science Journal*, published by the Atlantic Scientific Bureau, New Bedford, Mass. We wish the *Journal* much success, but its contents so far are amateurish in character.

Professor H. Kreutz, who, since the death of the late Professor Krueger, has been temporary editor of the *Astronomische Nachrichten*, has been appointed its editor by the Prussian Department of Education.

The bill passed by the New Jersey Legislature establishing a commission to investigate the forests of the State has been vetoed on the ground that the work can best be done by the Geological Survey.

The *New York Tribune* states that Mr. George W. Hammond, of Boston, has given to the Peabody Museum of Harvard University his private collection. It includes large numbers of stone implements from the European countries and many interesting relics of the Colorado cliff-dwellers, as well as specimens from various parts of the United States. It was understood that Harvard College could select all specimens desired for the Museum, and that those not wanted should go to Bowdoin College.

It is announced that a lady has given the sum of £70 towards the purchase of apparatus for the psychological laboratory in University College, London, to which we recently referred. Professor Carey Foster has offered temporary accommodation in the physical department and it is hoped that a lecturer will be secured in October.

WE have already called attention to the appointment of physicians to visit the New York schools. Mr. C. B. Hubbell, President of the Board of Education, advocates the appointment, under the Board of Health, of ten or twelve specialists to examine the eyesight and hearing of the children.

THE daily papers report that an earthquake shock of some severity was felt in Canada and in the northern parts of the State of New York at 10.15 p. m. on May 27th.

LIEUTENANT ROBERT E. PEARY has received leave of absence from the navy for five years. He will go this summer to Whale Sound, where he expects to find several families of Esquimaux who will form a colony further north and will spend the year collecting meat, furs, etc., which colony will be the base of supplies for a further northward advance. Lieutenant Peary will be accompanied as far as Melville Bay by several scientific parties, one under Professor G. H. Barton, of the Massachusetts Institute of Technology, and one under Professor C. H. Hitchcock, of Dartmouth College.

IT is announced that the Thomson Yates Laboratory of pathology and physiology of the medical department of University College, Liverpool, will be oppened by Lord Lister next spring. Mr. Thompson Yates has made further donations for interior fittings and for apparatus, bringing the amount of his gift to $125,000.

THE town of Dundee has decided to establish a bacteriological laboratory, thus granting the petition presented to the Town Council by the District Branch of the British Medical Association.

THE popular magazines for June contain a number of articles of scientific interest. Professor S. P. Langley contributes to *McClure's* an account of the successful working of his aërodome. The *Century* includes three illustrated articles: an account by Professor W. O. Atwater, of the experiments carried out under his direction regarding the use of food in the body; a description of the Harvard Observatory and its branch at Arequippa by Mrs. Todd, and a record of personal experience of home life among the Indians by Miss Alice C. Fletcher. In *Harper's* Mr. H. S. Williams writes on the meteorological progress of the century; in the *New England Magazine* Mr. G. E. Walsh describes forest culture of to-day, and in the *Arena* President David Starr Jordan publishes an article on the Heredity of Richard Roe.

THE Philadelphia Commercial Museum was formally opened on June 2d, in the presence of President McKinley and a number of other distinguished guests. Under the directorship of Professor William P. Wilson the Museum has assumed much importance and now concontains 50,000 exhibits of raw products and many manufactured articles. In addition to the collections of the Museum there is a library especially rich in statistical publications, consular reports, etc., and a Bureau of Information prepared to answer questions on all subjects germane to the scope of the Museum. The Museum is now occupying temporarily the old offices of the Pennsylvania Railroad on Fourth street, but the City of Philadelphia has set aside a site an appropriation of $200,000 for a building. The primary object of the Museum is to bring before manufacturers, dealers and consumers the products of the world, so that they may know what to purchase and what to export. In cooperation with our consular service and with the governments of foreign countries, the Museum will undoubtedly fulfill an important mission, not only for commerce and manufactures, but also for science.

THE first of the two annual conversaziones of the Royal Society was held on May 19th. Among the exhibits described in the English journals were the following: The new process (Dansac-Chassagne) of producing photographs in color, still kept secret, was illustrated in a series of prints in the various stages of treatment by Sir H. Truman Wood. In regard to recent work with the X-rays Mr. A. A. C. Swinton showed his new focus tubes, in which the distance between the cathode and anticathode may be adjusted so as to allow the production of rays of a maximum penetrative value. Mr. Heycock and Mr. Neville showed photographs when the X-rays had been allowed to pass through a sodium gold alloy, showing separately the crystals of gold (opaque) and of

sodium (transparent) existing in the alloys which otherwise appear to be homogeneous. Interesting results of the application of photography were shown in a somewhat similar line of research by Professor Roberts-Austen, who, by means of a microscope and camera and a highly magnifying apparatus, demonstrated the existence of minute diamonds (carbon crystals) in steel. A series of photographs was shown by Professor Norman Lockyer, the diagrams affording testimony of the value of the spectroscope and photography in enabling a simple classification of the stars to be made based upon their ascertained chemical composition. Photographs of the moon were exhibited by the Astronomer Royal. M. Guillaume performed an experiment showing the practically non-dilatable character of nickel steel on heating; its application to pendulums is thus suggested. The diffraction kaleidoscope exhibited by Mr. C. P. Butler used the pure spectrum of white light, the colors being reflected at a great number of angles. The Marine Biological Association's exhibit included marine animals illustrating 'commensalism,' a term used to indicate the constant association of animals with one another often for mutual advantages. Professor Oliver Lodge gave a demonstration of Zeeman's discovery of the broadening of spectrum lines by the action of a magnetic field on the source of light. A sodium flame was placed between the terminals of a powerful magnet. On turning on the current the normal bands become double, triple, or even quadruple. Some excellently mounted preparations shown by Dr. Kanthack illustrated the mode of action of the Tsetse fly. Mr. E. Edser and Mr. H. Stansfield exhibited apparatus showing the phase change of light reflected at a glass-silver surface. The apparatus is a modification of Michelson's differential refractometer, the interfering rays being reflected at the back surfaces of the end mirrors. Mr. C. T. Heycock and Mr. F. H. Neville showed some experiments on the superficial color changes of a silver-zinc alloy. In the meeting room Professor W. E. Ayrton gave an experimental demonstration of some electric and mechanical analogues, and Professor J. B. Farmer showed lantern slides from microphotographs illustrating nuclear divisions in animal and vegetable cells.

UNIVERSITY AND EDUCATIONAL NEWS.

THE United States Supreme Court has dismissed the appeal in the Merritt suit, and the bequests left by Mrs. Catherine M. Garcelon in 1891 will now be paid. Bowdoin College, Brunswick, Me., will receive $400,000 and a hospital will be established at Oakland, Cal., at a cost of $600,000.

AN attempt is being made to break the will of the late William Lampson, who bequeathed nearly a million dollars to Yale University. It is to be hoped that the aged aunt and forty-two cousins of Mr. Lampson may be no more successful than were the contestants of the will of Mrs. Garcelon! It seems unfortunate that it is possible for distant relatives to delay and often even to annul public bequests, and that American courts should be so much more disposed than those of European countries to admit objections to the validity of wills.

THE Teachers' College of New York receives $10,000 by the will of the late Mrs. Julia Augusta Kemp, and is also made her residuary legatee. It is now announced that Mr. Joseph Milbank was the donor who, in March, 1896, gave $250,000 for enlarging the Teachers' College. The new building, now nearly completed, will be called Milbank Memorial Hall.

THE Building Committee of the University of Montana, at Missoula, has decided to erect a main building at a cost of $47,500 and a science hall at a cost of $12,500.

APPLICATIONS for the Savilian professorship of geometry at Oxford University, vacant by the death of Professor Sylvester, must be received not later than June 12th. The salary is about $4,500 and the duties are confined to the delivery of forty-two lectures.

DR. E. G. JANEWAY, President of the New York Academy of Medicine, has been elected professor of medicine, and Dr. S. F. Dennis, professor of surgery in the faculty of the New York University Bellevue Hospital Medical College.

IT is stated in the daily papers that Dr. Antoneo Crocichia has been elected to the chair of biology in the Catholic University, Washington.

DR. J. S. ELY, professor in the Woman's Medical College, New York, has been elected professor of the theory and practice of medicine in the Medical School of Yale University.

WE learn from the *Botanical Gazette* that Dr. E. B. Copeland has been appointed assistant professor of botany in the University of Indiana in place of Dr. Geo. J. Peirce, who resigned to accept a similar position, in charge of plant-physiology in the Leland Standford Junior University.

DR. BECK, of the University of Lemberg, has been promoted to a full professorship of physiology, and Dr. Konrad Zeisig has been made second professor of physics in the Polytechnic Institute of Darmstadt. Dr. Deichmüller, observer in the observatory at Bonn, has been appointed associate professor. Dr. Ludwig Heim, of Würzburg, has been called to an associate professorship of bacteriology in the University of Erlangen. Dr. Hillebrand has qualified as docent in astronomy in the University at Vienna.

DISCUSSION AND CORRESPONDENCE.

THE DISCRIMINATION OF SPECIES AND SUBSPECIES.

DR. MERRIAM'S paper in SCIENCE for May 14 (N. S., Vol. V., No. 124, pp. 753–758), entitled 'Suggestions for a New Method of Discriminating between Species and Subspecies,' opens up a question of immense interest and far-reaching importance, respecting which there is room for two widely divergent opinions, both susceptible of support by arguments of considerable weight. Dr. Merriam cites the purely conventional and arbitrary rule adopted in the A. O. U. 'Code of Nomenclature' for deciding the status of closely related forms with reference to whether they are to be ranked as species or subspecies, and calls attention to the well-known inconsistencies sometimes resulting from its use. The failure of the rule to yield always satisfactory results is not due to the principle involved, but to the imperfection of our knowledge respecting what closely related forms intergrade and what do not. Consequently, it is urged, a stable nomenclature for such forms cannot be attained under this rule till we have a complete knowledge of the relations of such forms; in the meantime their status will be unstable, and their nomenclature, in this respect, subject to change as our knowledge of them increases.

The first part of the rule as summarized by Dr. Merriam (l. c., p. 753)—to wit: "Forms known to intergrade, no matter how different, must be treated as subspecies and bear trinomial names"—presents no difficulty of application and can be carried into effect without imperiling stability of nomenclature. The second part—namely, "forms not known to intergrade, no matter how closely related [or, rather, how closely they resemble each other], must be treated as full species and bear binomial names"—is difficult to apply always consistently. As Dr. Merriam says, "only in a small percentage of cases does an author have at his command a sufficiently large series of specimens, from a sufficient number of well-selected localities, to enable him to say positively that related forms do or do not intergrade;" and that consequently "authors usually exercise their individual judgment as to the *probable* existence or non-existence of intergradation," based, of course, on the nature of the differences, the geographical relationship of the forms, and on general grounds—on what is known to happen in other similar cases. Hence, naturally, some degree of inconsistency results in the use of trinomials, they being frequently employed where conclusive evidence of intergradation is lacking, though strongly indicated by the circumstances of the case. When later information shows that the true relationship of the forms in question has not been correctly indicated, their status must be changed, either from that of a species to a subspecies, or the reverse, as the case may require. But this, while undesirable, is not a serious change, since the 'special' name (specific or subspecific) is necessarily retained—a change far less important than the substitution of one name for another, as not infrequently becomes imperative from other causes.

The real question, then, is whether we can

not well afford to wait for any necessary rectifications of this sort rather than to adopt any alternative thus far suggested. I am heartily in sympathy with any effort to improve the present somewhat unsatisfactory method, and am glad Dr. Merriam has raised this important question for discussion, respecting which the comparison of opinions of experts in this line cannot fail to be interesting and profitable. I am also glad that Mr. Roosevelt has presented 'A Layman's Views on Scientific Nomenclature' (SCIENCE, N. S, Vol. V., No. 122, April 30, 1897), believing that such discussions have value in rendering clear the 'reason of things' under our modern phase of systematic zoölogy, as it has drawn forth Dr. Merriam's admirable exposition of the 'other side.'

I cannot, however, quite subscribe to Dr. Merriam's proposed remedy for this 'incurable inconsistency' and these 'inevitable changes' contingent on increase of knowledge. It is proposed that we base our recognition of species and subspecies on 'the degree of difference between related forms,' principally on the ground that "a knowledge of this is infinitely more important than a knowledge of whether or not the intermediate links connecting such forms happen to be living or extinct." In other words, it would be more useful "if the terms species and subspecies were so used as to indicate degree of difference, rather than the author's opinion as to the existence or non-existence of intergrades." On this point there is obviously room for difference of opinion. This phase of the subject, however, may be waived as aside from the main point, which I take to be the feasibility or non-feasibility of adopting the 'degree of difference' standard for species and subspecies. Yet I would like to add, in passing, that to me it is of far greater interest to know that the connecting links between quite unlike forms still exist, and that we have thus positive evidence of their genetic relationships, than to know that these forms, in their extreme phases, have become so far differentiated as to present differences as great as ordinarily characterize closely related species.

The real difficulty with the degree of difference principle is its elasticity; it enlarges to the widest possible extent the personal equation element, which is one of the alleged sources of dissatisfaction with our present system. Dr. Merriam's paper, taken as a whole, so far shows the wide influence of 'personal equation' in such matters that little need be added on this point, except by way of further illustration. The diversity of opinion respecting the amount of difference required to distinguish genera and subgenera is notorious; is it likely to be any less in the case of species and subspecies, in case degree of difference is taken as the basis of their recognition? In reply to this, reference may be made to the treatment of North American birds by the authors of the 'British Museum Catalogue of Birds,' on the one hand, and of the 'A. O. U. Check List,' on the other. In the former work some of the most worthless subspecies are given the rank of full species, while, on the other hand, many of the most strongly marked subspecies, and even some species, are wholly ignored, being reduced to synonyms, with often not a word of comment. And this is done not in one group, nor by one author, but in all groups and by each of the half-dozen or more eminent ornithologists who have contributed to this monumental work. This does not foreshadow any 'narrowing of bounds' of the personal equation element, nor give much hope of agreement on any 'degree of difference' standard for the basis of species and subspecies.

As is well known, not only a great deal depends on 'the point of view,' but also on the quantity and character of the material different authors may have before them, in relation to their conclusions on identical questions. The point of view, expertness and amount and kind of material are thus factors in the case, so that, whether we adopt the intergradation test or the degree of difference test, we are not likely to reach unanimity of opinion on such matters for a long time to come.

But there are other points that demand consideration. The advocates of the 'intergradation' test claim that it is based on a philosophic principle, and that the use of a binomial term means one thing and the use of a trinomial term means another and a very different thing.

Binomial names are given only to forms known or supposed to be non-intergrading—to

fully segregated species; trinomial names and forms known or supposed to intergrade, to incipient species or geographical forms, to species still in process of evolution. As said by the present writer some years ago (*Auk*, I., 1884, 201): "It hence follows that the terms species and varieties [or subspecies] are not interchangeable at will, but expressions for certain definite and known facts in nature, grounded on a philosophic principle, to ignore which is not only unscientific, but is to deprive us of a means of precise definition at a point where precision is of high importance."

It thus seems to me better to maintain our theoretically hard-and-fast standard for regulating the status of closely related forms than to adopt so elastic and unphilosophic a basis, and one withal so eminently open to the influence of personal equation, as the 'degree of difference' criterion must inevitably be, and allow time and research to correct the lapses that may occur under our present system.

J. A. ALLEN.

TO THE EDITOR OF SCIENCE: I have been greatly interested in Dr. Merriam's article as to discriminating between species and sub-species. With his main thesis I entirely agree. I think that the word 'species' should express degree of differentiation rather than intergradation. I am not quite at one with Dr. Merriam, however, on the question as to how great the degree of differentiation should be in order to establish specific rank. I understand entirely that in some groups the species may be far more closely related than in others, and I suppose I may as well confess that I have certain conservative instincts which are jarred when an old familiar friend is suddenly cut up into eleven brand new acquaintances. I think he misunderstands my position, however, when he says, "Why should we try to unite different species under common names?" He here assumes, just as if he were a naturalist of eighty years ago, that a 'species' is always something different by its very nature from all other species; whereas the facts are that species, according to his own showing in the beginning of his article, are merely more or less arbitrary divisions established for convenience's sake by ourselves, between one form and its ancestral and related forms.

I believe that with fuller material Dr. Merriam could go on creating new 'species' in groups like the bears, wolves and coyotes until he would himself find that he would have to begin to group them together after the manner of the abhorred 'lumpers.' His tendency to discover a new species is shown by the allusion in the last part of his article to the 'unknown form of wapiti,' which has been exterminated from the Allegheny country. The wapiti was formerly found in the Allegheny regions; there it was beyond a doubt essentially the same animal that is now found in the Rockies. Probably it agreed more closely with the wapiti of Minnesota, which still here and there survives, than the latter does with those of Oregon. It may have been slightly different, just as very possibly a minute study of wapiti from the far south, the far north, the dry plains, the high mountains and the wet Pacific forests might show that there were a number of what Dr. Merriam would call 'species' of wapiti. If this showing were made, the fact would be very interesting and important; but I think it would be merely cumbrous to lumber up our zoological works by giving names to all as 'new species.' It is not the minor differences among wapiti, but their essential likenesses, that is important.

So with the wolves. Dr. Merriam has shown that there are different forms of wolf and coyote in many different parts of the country. When he gets a fuller collection I am quite sure he will find a still larger number of differences and he can add to the already extensive assortment of new species. Now, as I have said before, it is a very important and useful work to show that these differences exist, but I think it is only a darkening of wisdom to insist upon treating them all as a new species. Among ordinary American bipeds, the Kentuckian, the New Englander of the sea coast, the Oregonian, the Arizonian, all have characteristics which separate them quite as markedly from one another as some of Dr. Merriam's bears and coyotes are separated; and I should just as soon think of establishing a species in the one case as in the other.

Some of the big wolves and some of the coyotes which Dr. Merriam describes may be entitled to specific rank, but, if he bases separate species upon characters no more important than those he sometimes employs, I firmly believe that he will find that with every new locality which his collectors visit he will get new 'species,' until he has a snarl of forty or fifty for North America alone; and when we have reached such a point we had much better rearrange our terminology, if we intend to keep the binomial system at all, and treat as a genus what we have been used to consider as a species. It would be more convenient and less cumbersome, and it would be no more misleading.

Dr. Merriam states that the coyotes do not essentially resemble each other, or essentially differ from the wolves. It seems to me, however, that he does, himself, admit their essential difference from the wolves by the fact that he treats them all together even when he splits them up into three supra-specific groups and eight to eleven species. He goes on to say that there is an enormous gap between the large northern coyote and the small southern coyote of the Rio Grande, and another great gap between the big gray wolf of the north and the big red wolf of the south, while the northern coyote and the southern wolf approach one another. Now I happen to have hunted over the habitats of the four animals in question. I have shot and poisoned them and hunted them with dogs and noticed their ways of life. In each case the animal decreases greatly in size, according to its habitat, so that in each case we have a pair of wolves, one big and one small, which, as they go south, keep relatively as far apart as ever, the one from the other. At any part of their habitat they remain entirely distinct; but as they grow smaller toward the south a point is, of course, reached when the southern representative of the big wolf begins to approach the northern representative of the small wolf. In voice and habits the differences remain the same. As they grow smaller they, of course, grow less formidable. The northern wolf will hamstring a horse, the southern carry off a sheep; the northern coyote will tackle a sheep, when the southern will only rob a hen-roost. In each place the two animals have two different voices, and, as far as I could tell, the voices were not much changed from north to south. Now, it seems to me that in using a term of convenience, which is all that the term 'species' is, it is more convenient and essentially more true to speak of this pair of varying animals as wolf and coyote rather than by a score of different names which serve to indicate a score of different sets of rather minute characteristics.

Once again let me point out that I have no quarrel with Dr. Merriam's facts, but only with the names by which he thinks these facts can best be expressed and emphasized. Wolves and coyotes, grizzly bears and black bears, split up into all kinds of forms, and I well know how difficult it will be and how much time and study will be needed, to group all these various forms naturally and properly into two or three more species. Only a man of Dr. Merriam's remarkable knowledge and attainments and ability can ever make such groupings. But I think he will do his work, if not in better shape, at least in a manner which will make it more readily understood by outsiders, if he proceeds on the theory that he is going to try to establish different species only when there are real fundamental differences, instead of cumbering up the books with hundreds of specific titles which will always be meaningless to any but a limited number of technical experts, and which, even to them, will often serve chiefly to obscure the relationships of the different animals by over-emphasis on minute points of variation. It is not a good thing to let the houses obscure the city.

Theodore Roosevelt.

Washington, D. C.

GLACIAL MAN IN OHIO.

I have read 'Human Relics in the Drift of Ohio' and Dr. Brinton's criticism of the same in Science of February 12th.

The gist of Professor Claypole's paper is based upon the discovery of a polished stone axe, made by a well-digger in Ohio ten years before.

Not with especial reference to this discovery, but *apropos* of the danger of accepting any statement at second hand even from the most veracious person (for we are all liable to error), I would like to cite two personal experiences

which occurred during my mound-work in Florida.

At one time I had almost completed the slicing-down of a large mound in which no object in any way connected with Europeans had been found.

While my back happend to be turned I heard a cry and went to the colored digger from whom it came and who, I found, held in his hand an iron spike—a sure sign of European contact.

"From where did this come?" I asked.

The digger did not seem to comprehend my question and, as time pressed, I asked a leading question, which no investigator should do. I inquired again, "Did it come from the base?"

"Yes, sah, from de base," replied the digger.

I was somewhat nonplussed, for I never had (and never have) dug down a mound of any size where artifacts of white origin were present other than superficially.

Suddenly an idea struck me. "Where is the base?" I asked.

"Why, at de top, sah," replied the digger.

Once in conversation with a very intelligent man, the leading citizen of a town on the Ocklawaha river, I was somewhat startled at the information that the speaker had in his house a grooved stone axe found on his place.

I pointed out that no report had yet appeared as to the discovery of a grooved axe in Florida. The speaker was positive. He *knew* he was right. I asked him, as a favor, to consult with his family at dinner as to the matter and to let me know later on.

In the afternoon he called on me and stated that the grooved stone axe was a present from a friend in Alabama and that the implement found on his place had no groove.

CLARENCE B. MOORE.

THE SMITHSONIAN INSTITUTION AND A NATIONAL UNIVERSITY.*

SINCE our conversation about the organization and purpose of the Smithsonian Institution I have been thinking much about the matter. Certain things seem clear. The Institution is at the National Capital; whatever it does must represent the best there is in the country. The plan of its foundation and the purposes of the founder were broad; it ought, if it can be found in any way practicable, to represent more than one, two or three branches of scientific knowledge. The problem is how, with the limited fund at disposal, to combine the two things, supreme excellence and wide scope.

I think I can conceive of a plan. Whether it is practical or not will be for others who are nearer at hand and better acquainted with the details to determine.

Since the Institution began its work the conditions of scientific work in this country have radically changed. There were then but few recognized departments of scientific endeavor; now the differentiation of the sciences has advanced into great multiplicity. Then a single man was able to cover a large field and there were Humboldts in the land; now a man may not venture to call himself a chemist, but defines his specialty as Physical Chemistry, Agricultural Chemistry, Chemistry of Gases, Inorganic or Organic Chemistry, etc. Then there were no universities in the present sense. There were no institutions where any large number of different scientific fields were occupied by advanced investigators. There were colleges which taught, not universities which learned.

It is now no longer possible for the Smithsonian Institution to compete, even in a single department, with the larger universities. According to its present organization it has, and can have, but one or two men for one or two departments. There are now a half-dozen universities that can and do employ a considerable force of men for each of a large list of scientific departments, each of which is equipped with laboratories, apparatus and collections. A man who permanently establishes himself in residence at Washington at the Institution cuts himself off from many associations he would find at a university. He loses the opportunity of laboratories and carefully assembled collections of the literature of his subject. He loses the stimulus of teaching and of working with investigators and of directing investigations. The Smithsonian Institution is not a university and

*A letter addressed by Professor Benjamin Ide Wheeler, of Cornell University, to the Hon. Gardiner G. Hubbard, Washington, and published here with the permission of Professor Wheeler and Mr. Hubbard.

cannot become one. It would be vain for it to attempt to duplicate the outfit of a modern university.

Its mission and its opportunity is *to utilize the existing mechanism* of the scientific departments *of all the different American universities.* In some sense also it may coordinate them and unite them.

At present, at least, there seems to be no place for a National University at Washington, certainly not in the sense that another university should be added to those that now exist in the country, like them or only a little better than any one of them.

By coordinating and uniting what now exists, the Smithsonian Institution may well furnish, at least in reference to the aggressive scientific work of the country, the beginnings of such a National University as is really needed.

I think it would be practically possible to make a beginning in this direction in the following way:

1. Establish and recognize a certain number of scientific departments, say fifteen at the start. Let all these be recognized as constitutive parts of the Institution.

2. Appoint, by careful selection, a committee of three men, the most eminent in their lines to be found in the country, to represent each department. (This the least essential part of my suggestions.)

3. Make one man the chairman and assign him a salary appropriate to the work expected of him.

4. Let these men, the chairmen, remain, if so already, professors in active service in the universities where they belong. Secure for them, from these universities, the right to spend a certain portion of each year at Washington, say six to ten weeks, in some cases perhaps much less. Let their salaries be additional to their university salaries, in case their universities consent to allow them the time as a vacation; otherwise make these salaries a portion of their university salaries. The latter course may be necessary in cases where a man is regularly absent from his university work as much as one-third of the university year. This plan would be of advantage to the men, because of the opportunity and the prestige; to their universities, because of the advantage it would be to the men themselves; to the Institution, because of the work they would do, better and larger than the Institution could secure from men whose entire services it would be able to obtain.

5. Each man put in charge of a department would do such work in upbuilding and helping his department as he, in consultation with his committee, found practical and advantageous to do. Some could devote themselves to the collections; some would lecture or arrange courses of lectures; some would organize, stimulate and assist work in their departments going on in different parts of the country. Some would use the opportunity to interest the National Government in enterprise akin to their work, and to influence the conduct of those already undertaken.

This is a suggestion of a way to begin what would, I believe, develop into something of great use to the country, and would furnish a true and fit utilization of the existence of the Institution in its present habitat and with its present conditions.

Sincerely yours,

BENJ. IDE WHEELER.

SCIENTIFIC LITERATURE.

Outlines of Psychology. By WILHELM WUNDT. Translated by CHARLES HUBBARD JUDD. Leipzig, Wilhelm Engelmann. 1897. 8vo, pp. 342.

An Outline of Psychology. By EDWARD BRADFORD TITCHENER. New York, The Macmillan Company. 1897. 8vo, pp. 352.

The fundamental aim and interest in both these treatises is the instructional one; while by no means limited to this phase of utility, the volumes are primary text-books and may be judged by their fitness to increase the efficiency and attractiveness of the teaching of psychology. Such a verdict would be much easier to reach were there a more complete agreement as to the content or the methods, the order of exposition or the perspective of importance, of the several trends of investigation that lend diversity as well as frequent confusion to psychological discussions. But the 'psychologies' are unmistakably converging both in matter and manner, and it is becoming less

hazardous to predict the general nature of the contents of a volume upon the basis of the occurrence of the word 'Psychology' on its title-page.

The two works are, moreover, quite similar in size and scope; they are equally methodical and systematic; they reflect in each case the well defined convictions of the author, and the author in each case is an experimentalist thoroughly in touch with a rigid scientific conception of the methods and problems of mental investigation. A still further note of agreement is to be found in the strong insistence upon the specifically psychological aspect of the questions considered; physiological considerations are reduced to a minimum, and philosophical speculations are, in almost all instances, avoided, except when they seem to be required to furnish a basis for psychological interpretations. The reader never loses sight of the fact that the subject under discussion, whether sensation or perception, whether attention or movement, whether the sentiment or reasoning, is always treated as a strictly and exclusively psychological problem, as a description, classification, interpretation, analysis and explanation of a mental process or product. This trait gives a very impressive sense of consistency, order and completeness to the expositions. It arouses the agreeable feeling that, in spite of all the discussions and controversies, in spite of all schools and attitudes, there really is a science of psychology; that psychology is not merely a shapeless region as yet unoccupied by the adjoining domains of the sciences and upon which these sciences may encroach at pleasure, but a definitely organized country with distinctly recognizable boundary lines. Of course, this agreeable feeling is apt to be disturbed when we turn to other phases of modern psychological literature; but it is a welcome resource, and particularly so for the student to have such an exposition to fall back upon. This end is gained at a considerable sacrifice of suggestiveness and attractiveness; but it is obviously the deliberate plan of both authors, and in both cases the plan is well carried out.

As between the two—for the odium of comparison does not obtain, when the two things compared are really comparable—the preference of American teachers and readers will be for Professor Titchener's work. The American student seems to require not merely a road-map and sign-posts, but a personal guide, or at least an illustrated and attractive guide-book; he needs not merely an opportunity to go right, but an incentive to keep going, as well as frequent corrections of tendencies to pursue misleading and aimless side paths. Such direction he is much more likely to find in Professor Titchener's pages than in those of Professor Wundt; he is not likely in either case, however, to find as attractive a path as he had hoped for, and will find many regions through which the path is difficult to follow and by no means easy when found. Psychology has a very unfortunate reputation in the minds of the college student, as a study peculiarly difficult, to be pursued by methods unusual and intricate. A perfect text-book would minimize the grounds for such a reputation by constantly assimilating the unfamiliar by the aid of the familiar. Many a student who enters upon the study of that section of psychologic optics dealing with the perceptive powers of the outlying parts of the retina fails to obtain the proper results, because of his difficulty in fixing his gaze at one point and his attention at another, or because he allows his eyes to roam about when they should be rigidly fixed. The usual and useful method of seeing is to focus the gaze and the attention together and to allow the eyes freely to move about and explore the field of view, but for the study of the analysis of space perception it is necessary to overcome this tendency and to acquire an unusual mode of vision. Such, in some measure, is the relation between the daily mental experience by means of which every one acquires a real acquaintance with mental processes and results and the technical study of psychology. But the contrast between these two attitudes should not be allowed to interfere with the easy and attractive transition from one to the other, nor with the correct appreciation of the function and place of each. The student should not be tempted to observe the world by indirect vision, but he should be led to acquire the tendency to observe unapparent details and to gain an insight into the significance of what is common and obvious. It is

just here that a strictly systematic, rigidly methodical and abstractly analytical text-book of psychology will fail as a pedagogical instrument. If it be a sound psychological doctrine that assimilation demands attention and attention is fed by interest, then the creation and maintenance of an interest is an essential of every text-book, as it is of every teacher. It may be well urged that for this purpose an ounce of teacher is worth a pound of text-book, but even the teacher is better equipped to inspire if he preaches from an inspiring text.

It remains to indicate very briefly the distinctive features and contents of the two books. Following an introductory chapter upon the nature of psychological problems, Professor Titchener devotes three chapters to the simplest element of consciousness, sensation, treating it in its qualitative and quantitative aspects and dwelling as well upon the methods of studying sensation. The affective side of mental life is considered in three somewhat widely separated chapters, first as simple affection, then as feeling and emotion, and again as sentiment. Similarly the will, the active side of psychic phenomena, is considered, first as conation and attention, then as voluntary movement, and (in connection with other processes) in the reaction synthesis. The elaborations of sensation, the complexes to which they lead, are treated under the usual headings—perception, ideas, recognition, memory, imagination, self-consciousness and reasoning. It is thus apparent that the method and order of exposition begins with the simplest elements of consciousness—the last results of analysis—and then considers in turn the compounds and elaborations into which these elements are built up.

Professor Wundt's scheme involves a more elaborate systematization. He devotes considerable space to the general methods and problems of psychology by way of introduction, and then discusses the processes of mental life; first, as psychical elements (sensation and simple feelings); second, as psychical compounds (ideas of intensity, space, time, location, etc., as also composite feelings, emotions and volitional processes); third, as interconnection of psychical compounds (consciousness, attention, association, memory, apperception, etc.); fourth, as psychical developments (the mind of animals, of the child, of society and the race); and finally concludes by the discussion, under the title 'Psychical Causalty and its Laws,' of a problem which belongs quite as much to philosophy as to psychology.

As a translation inherently difficult the result is creditable; but it hardly reaches the ideal criterion of the art that conceals art, for the book seems un-English on every page. The type, the binding, the manner of construction, are all unmistakably German and, together with the foreign terminology and mode of presentation, detract considerably from the possible attractiveness of the volume to the English reader.

Viewed as independent contributions to psychology, both works present a considerable measure of originality. The student of Wundt will naturally turn to his other writings for a more complete exposition of his interpretations of psychological problems, but will find in the 'Outlines' (for instance, in the discussion of psychological methods and classification) many pages that form an essential contribution to his published work. Similarly in Professor Titchener's volume one recognizes many a doctrine and exposition that reflects the outcome of special and original investigation, as well as a position resulting from recent research. Viewed both as text-books and as contributions to psychological discussion, the volumes may unhesitatingly be pronounced welcome and interesting; the further proof of their utility must await the test of time and use.

Joseph Jastrow.

University of Wisconsin.

GEOLOGIC ATLAS OF THE UNITED STATES. *Folio 23, Nomini, Maryland-Virginia, 1896.*

This folio consists of four pages of text signed by H. N. Darton, geologist, a topographic map of the district, a map showing the areal geology, and a map showing the distribution of underground waters and artesian wells. The scale of these maps is 1:125,000.

The area represented in this folio is about 938 square miles, which lies partly in Virginia and partly in Maryland. In Virginia it comprises nearly all of Westmoreland county, with parts of Essex, Northumberland and Richmond,

and in Maryland it includes portions of St. Mary, Charles and Calvert counties. It lies entirely within the Costal Plain area. The Potomac river extends northwest and southeast across the middle of the area; the Patuxent river crosses its northeastern corner, and the Rappahannock river crosses its southwestern corner. To the extreme northeastward it extends to the shore of Chesapeake Bay. These waters are all tidal estuaries. Along the river valleys there are wide, low terraces, capped by the Columbia formation, of Pleistocene age. The intervening areas are plateau remnants, capped by Lafayette deposits, of supposed Pliocene age. The underlying formations are the Chesapeake and Pamunkey, the latter extending from the westward only a few miles into the area, along the north side of the Potomac river.

The Pamunkey formation, of which only the uppermost beds are exposed, consists in greater part of glauconitic marls of Eocene age. It is overlain unconformably by the Chesapeake formation, which is characterized by fine sands, marls and clays, portions of which consist largely of diatomaceous remains. The formation is very fossiliferous at some localities. Its age is Miocene. The greatest thickness which it presents in the Nomini area is about 270 feet, but it continues to thicken gradually to the eastward.

The Lafayette formation, which ranges from 25 to 40 feet in thickness, consists of sandy loams of orange, brown and buff tints, often variegated, containing irregularly disposed bands and sprinklings of small quartzite pebbles and coarse sands. The pebbles and larger sand grains are orange-tinted, mainly by superficial staining. The plateau surface, capped by this formation and deeply incised and dissected by the larger drainage depressions, inclines gently southeastward at an altitude ranging from about 190 feet along the northern and western border of the area to about 90 feet along its eastern border. Its greatest altitude is 200 feet in a portion of Nomini cliffs. It has also in most cases a slight slope into each of the river valleys.

The Columbia formation is a deposit of loam merging downward into coarser materials containing beds of quartzite, gravel and boulders. Its thickness averages about 20 feet. Its surface extends from altitudes of 5 to 60 feet above tide level.

The principal economic features are underground waters, which on the lower lands furnish flows for artesian wells. Three water-bearing horizons are known—one at the base of the Pamunkey formation, another 100 feet higher in the Pamunkey formation, and a third in the lower sandy members of the Chesapeake formation. They all dip to the eastward at a very moderate rate. There are many artesian wells which obtain water supplies from 160 to 305 feet. On the artesian well sheet of the folio distinctive underground contours are given to show the depths below tide level to all of the water-bearing horizons.

Other economic resources of the area are marls in the Pamunkey and Chesapeake formations, diatomaceous deposits in the Chesapeake formation which are often sufficiently pure for commercial use, brick clays, potters' clays, sand and gravel.

Folio 26, Pocahontas, Virginia-West Virginia, 1896.

This folio, by Marius R. Campbell, consists of five pages of text, a topographic sheet (scale 1: 125,000), a sheet of areal geology, one of economic geology, another of structure sections, and, finally, a sheet giving a generalized columnar section of the district.

The territory mapped and described in this folio embraces an area of 950 square miles, the southern portion of which is in Virginia and the northern portion in West Virginia. It is located west of New (Kanawha) river, at the place where the State line leaves East River Mountain, the last of the valley ridges toward the northwest, and follows the irregular crests of the ridges within the coal field. The southern portion of this territory is within the limits of the Appalachian valley, and its surface is marked by linear mountains and narrow valleys, which are the characteristic forms of this central division of the Appalachian province. The northern portion is within the Cumberland plateau region, and its surface is that of a table-land deeply dissected, so that it now presents a confused mass of irregular ridges and hills,

only the summits of which reach the original level of the plateau.

The geologic structure of this region varies as the topography varies. In the northern portion the rocks are nearly horizontal, their northwestward slope being rarely more than 200 feet per mile, whereas in the southern portion the rocks have been highly compressed in a horizontal direction, forming huge folds, which in many places have broken, allowing one portion of the fold to slip over the other. It is this tilted condition of the strata which gives rise to the regular topographic forms of the Appalachian valley. The attitude of the rocks is shown on the structure-section sheet by four sections which cross various portions of the territory.

The geologic history of this region is recorded in the rocks, which tell of prevailing marine conditions from early Cambrian to late Carboniferous time. There were deposited during that time sediments to the extent of 17,000 or 18,000 feet in thickness, which have since been hardened into limestone, shale and sandstone. Of this great mass the limestones form about 6,700 feet; the shales, 9,500 feet, and the sandstones, about 1,400. On lithologic grounds these have been divided into twenty-three separate and distinct formations, which are shown on the general geologic map by various colors and patterns.

There is little variety in the mineral resources of this region. Coal, iron ore and marble constitute about all of the mineral wealth of the territory. A limited area of coarse gray marble occurs along the northern front of Big Walker Mountain, but no development has been undertaken.

Iron ore occurs in two formations of the Upper Silurian rocks. It is of good quality, and probably in sufficient quantity to be of commercial importance, but its inaccessibility has prevented development.

Coal is by far the most important mineral resource of this region. The territory represented by this sheet embraces almost the entire Flat Top or Pocahontas coal field at present developed. All operations are confined to the great No. III. or Pocahontas seam of coal, which is semi-bituminous and ranges in thickness from 4 to 10 feet. It is exposed along the valley of Bluestone river from Pocahontas to the edge of the territory, along Tug Fork, in the valley of Elkhorn creek, from Coaldale to Kimball, near the edge of the area and at several places on the head streams of Guyandotte river. Mining is restricted to the Bluestone region and the valley of Elkhorn creek. In these two areas there are at present in operation thirty-seven distinct mines, which in 1894 produced 3,096,867 long tons of coal.

Folio 28, Piedmont, West Virginia-Maryland, 1896.

This folio consists of six pages of text, signed by N. H. Darton and Joseph A. Taff, geologists, and closing with a series of vertical sections showing the positions and thicknesses of the coal beds; a topographic map; a sheet showing the areal geology of the district; another showing the economic geology; a third exhibiting structure sections, and a fourth containing a columnar section and a key to the synonymy of the various formation names. The maps are on a scale of 1:125,000.

The area represented is about 925 square miles. In Maryland it comprises the southern portion of Garrett county and a small area in the southwestern corner of Allegany county. In West Virginia it includes nearly all of Grant county, the western portions of Hardy and Mineral counties, the northeastern portion of Tucker county, and a narrow area of Preston county, adjacent to the Maryland boundary line. Its southeastern corner is in a region of Appalachian ridges, and it extends northwestward over the Allegheny Mountains and the upper Potomac coal basin to the headwaters of the Youghiogheny river, a branch of the Monongahela river.

The geologic formations comprise members ranging from the sandstones in the middle of the Silurian to the upper Coal Measures of the Carboniferous. In the southeastern portion of the area there are two sharp anticlinal uplifts which bring up the Silurian rocks in two prominent mountains, New Creek Mountain and Patterson Creek Mountain. To the westward lies the coal basin, which extends from the Allegheny front to the Backbone Mountain. Along its center is cut the deep gorge of the north branch of the Potomac river. The basin is a relatively shallow

one, but it contains about 3,000 feet of Carboniferous deposits. To the westward is the anticlinal region of Devonian rocks which underlie the characteristic glade country about Oakland, Mountain Lake Park and Deer Park. West of Oakland is another synclinal basin, containing about 2,500 feet of Carboniferous beds.

The geologic classification does not differ materially from that outlined by W. B. Rogers and others, but geographic names have been applied to all of the formations. The lowest members are a series of sandstones and quartzites, which have been referred to as No. IV. and 'Medina.' This series has been subdivided into the Juniata formation, consisting of brownish-red sandstones and shales; the Tuscarora quartzite, and the Cacapon sandstones, consisting of thin-bedded red sandstones. Next there is the representative Clinton formation, which has been designated the Rockwood formation, as in other folios; the Lewistown limestones, including representatives of the Helderberg and associated limestones, and the Monterey sandstones, Romney shales, Jennings formation and Hampshire formation, representing the Devonian deposits. As the last three formations are not sharply separated from one another, the patterns by which they are represented on the map are merged in a narrow zone along their boundaries. The Carboniferous period is represented by the Pocono sandstone; the Greenbrier limestone; the Canaan formation, which in a general way is a representative of the Mauch Chunk shales; the Blackwater formation, which represents the Pottsville conglomerate in greater or less part; the Savage formation and Bayard formation, which are the Lower Coal Measures; the Fairfax formation, or Lower Barren Measures, and the Elk Garden formation, a part of the Upper Coal Measures.

The principal coal beds are in the Savage formation, containing the 'six foot' or Davis coal bed; the Bayard formation, containing the coal bed known as the 'four-foot,' or 'three-foot,' or 'Bayard,' or 'Thomas' coal, and the Elk Garden formation, containing the 'fourteen-foot' coal bed.

On the economic sheet of this folio the coal-bearing formations are strongly emphasized, and underground contours are introduced to show the lay of the 'six-foot' coal bed in the Savage formation for each 100 feet. Other economic resources of the area are red hematite iron ores in thin beds in Rockwood shales and limestones at several horizons, of which the lower member in the Lewistown is locally available for cement.

Folio 29, Nevada City Special, California, 1896.

This folio, by Waldemar Lindgren, consists of seven pages of text, three special topographic maps (scale 1:14,400)—the Grass Valley, Nevada City and Banner Hill—three corresponding maps showing the economic geology, and three others giving structure sections.

These maps, on a scale of about four inches to the mile, have been prepared to illustrate the detailed structure of the gold-mining regions in the vicinity of Nevada City and Grass Valley. Each of them comprises an area three miles wide by four miles long, the total area being nearly thirty-six square miles. The Nevada City and Grass Valley areas fall within the boundaries of the Smartsville atlas sheet, while the larger part of the Banner Hill area falls within those of the Colfax atlas sheet. The relief is that common to the middle foothill region of the Sierra Nevada—that is, the surface is a very irregular and undulating plateau, deeply trenched by the canyons of the recent river systems.

Sedimentary rocks, chiefly referred to the Calaveras formation, occupy small, usually narrow and long areas imbedded in the predominating igneous masses. Granodiorite occupies a large part of the Nevada City and Banner Hill districts, while a small massif of the same rock is found in the Grass Valley district. Large areas of diabase, porphyrite and brecciated forms of these rocks surround and separate the granodiorite areas. In the southwestern part of the Nevada City district and the northeastern part of the Grass Valley a large and complicated massif is found, consisting in part of diorite, in part of gabbro, pyroxenite and serpentine.

The slates of the Calaveras formation are the oldest rocks. Next younger are the diorities, gabbros and serpentines. Still later are the diabases and porphyrites, and the intrusion of granodiorite closes the succession of igneous rocks.

The bed-rock series is, as usual, in places covered by several hundred feet of Neocene gravels and rhyolitic and andesitic tuffs, the gently sloping top of the andesitic ridges forming a principal feature of the landscape.

The Neocene auriferous gravels have been extensively worked in the Nevada City and Banner Hill districts, both by the drifting and the hydraulic processes, and considerable ground still remains which probably can be profitably worked. The gold-quartz veins are numerous and belong to several distinct systems. They are found in any of the formations represented on the sheet, and generally cross the contacts without change. In the Banner Hill district the veins are narrow but rich, and have a general east-west direction and a northerly or southerly dip. In the Nevada City district the quartz veins have a general north-south direction and an easterly dip of of about 45°. Large dislocations producing over-thrust faults have occurred along several of the veins. In the Grass Valley district there is one system with a west-northwest direction and a steep northerly or southerly dip. On this system the celebrated Idaho mine is located. Most of the veins in the central and southern part of the district have a northerly direction and a flat easterly or westerly dip. The veins are often accompanied by strongly developed sheeting of the country rock.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE June number begins with an article by Theo. Holm, the fourth in a series of studies on the Cyperaceæ. This contains a full morphological and anatomical study of the species *Dulichium*, and is illustrated by a page of figures. J. C. Branner discusses the subject of bacteria in relation to the decomposition of rocks. The literature of the subject is reviewed and references given to various authors who have believed that the bacteria played an important part in this direction. The author decides, however, that it is highly improbable that any considerable amount of rock decomposition is due to this cause. J. H. Pratt and H. W. Foote describe a new mineral species from the Corundum mine, of Buck Creek, Clay county, North Carolina, to which they have given the name *wellsite*, after Professor H. L. Wells, of New Haven. The mineral belongs to the zeolites and is a silicate of aluminum, barium, strontium and calcium, crystallizing in the monoclinic system. It is particularly interesting since it forms another member of the Phillipsite group to which the species *Phillipsite*, *Harmotome* and *Stilbite* belong.

Howard D. Day discusses the magnetic increment of rigidity of wires in strong magnetic fields. The special subject discussed is "the increase of resistance to torque produced by the magnetization of twisted wires of various diameters, when the magnetic field increases to many times the amount needed to bring out the ordinary magnetic saturation. The object of the research was to make a clear comparison between the phenomenon of magnetization or magnetic intensity, on the one hand, and the phenomena of magnetic rigidity on the other; to show that the two are quite distinct in character—that the former practically subsides in relatively weak fields, whereas the latter are not as fully complete even in the highest fields applied." The apparatus employed is described and figured, and the results presented in a series of curves. It is seen that "as the fields become stronger the increment of rigidity varies more and more regularly with the twist, the tendency being that in fields indefinitely large the increment of rigidity would be proportional to the twist applied."

P. F. Schneider describes a geologic fault at Jamesville, near Syracuse, N. Y. The interest of the matter lies largely in the fact that this region has been shown to be characterized by a number of igneous dikes. H. L. Wells and H. W. Foote have two articles on chemical subjects, the first describing certain double halogen salts of cæsium and rubidium, and the second being devoted to the double fluorides of zirconium with lithium, sodium and thallium.

A. St.C. Dunstan, M. E. Rice and C. A. Kraus give the results of some observations made on the broadening of sodium lines by intense magnetic fields. Their results confirm the recently published work of Zeeman. They state that using fields ranging from 0 to 7800

C.G.S. units, they have found that the percentage broadening is directly proportional to the field strength; the absolute amount for sodium in a unit field being 11.46×10^{-6} Angström units.

A. A. Michelson describes some recent experiments, having as their object the discussion of the question as to whether there is a relative motion of the earth and the ether. Light from a certain source was separated into two pencils by a plane-parallel glass plate, and carried by two equal paths back to the observing telescope, where the interference fringes resulting could be observed. The apparatus was set up in a vertical east and west plane, the path being 200 feet long and 50 feet high. In order to eliminate disturbances due to temperature, the path of the light was inclosed in an iron pipe exhausted to within $\frac{1}{100}$ of an atmosphere. It was then found possible to measure the position of the central bright fringe to within something like $\frac{1}{20}$ of a fringe-width. The results of the measurements go to show that if there is any displacement of the fringes it is less than $\frac{1}{10}$ of a fringe. Hence it follows that the earth's influences upon the ether extends to distances comparable to the earth's diameter. The author concludes by saying that with these results before us we are driven to one of the three following extraordinary conclusions:

"1. The earth passes through the ether (or rather allows the ether to pass through its entire mass) without appreciable influence. 2. The length of all bodies is altered (equally?) by their motion through the ether. 3. The earth in its motion drags with it the ether even at distances of many thousand kilometers from its surface."

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON, MEETING OF MAY 12, 1897.

UNDER the title 'Physiography of the West Coast of Peru,' Mr. S. F. Emmons described some of the prominent physiographic features noted by him during a recent and rather hurried journey along the west coast of Peru as far as 16° south latitude, and on a trip on the Oroya railroad from Lima up to the western crest of the Andes and back.

First, he noticed the remarkable difference in rainfall and consequent change in vegetation experienced in the few hours' sail from the mouth of the Guayaquil River, in Ecuador, to the most northern part of Peru. From a region of copious rains and tropical luxuriance of vegetation and often dense forests one passes, over night, to a region where it rains once in seven years, and farther, to where it is absolutely rainless. As far as seen, there is no tree growth on the west slope of the Andes in Peru. In the larger valleys, on the other hand, where irrigation is possible, sugar, cotton, and all varieties of cereals, vegetables and fruits flourish under cultivation. The most evident cause of this condition of things lies in the fact that the wind along the coast blows almost continuously from the south, coming from a colder to a warmer atmosphere, or one whose capacity for carrying moisture is constantly increasing. Hence there is no condensation until the wind currents strike the high mountain slopes. In Ecuador the influence of the highly-charged equatorial currents is felt, and near the mouth of the Guayaquil River the continental watershed pushes westward to within 50 miles of the coast, thus presenting a condensing barrier on the land to the northward-moving currents.

A second striking feature is the enormous extent to which the coast bluffs and the northern slopes of the mountains that approach the sea are covered by white drifting beach sands borne along by the same prevailing south wind. At one point these sands, beautifully ripple-marked, completely mantled the southeast side of a deeply cut mountain valley to an elevation of four to five thausand feet above the sea level, and sand fields were observed inland, along north and south depressions in the elevated plateaux or pampas, 40 to 50 miles from the coast.

Striking evidences of recent elevation and subsidence of the coast regions are most frequent, and where the coast line is formed, as it frequently is, of soft and readily disintegrable Tertiary beds it is seen to be rapidly wearing away under the influence of the long and powerful waves of the Pacific Ocean. Near Pacasmayo a river valley is seen to have been

truncated by this wearing action and at the same time to have been elevated about 50 feet within a comparatively short time. Near Lomas a Tertiary plain 15 to 10 miles wide, and reaching 500 to 600 feet above tide, between the mountains and the sea, has been so recently reclaimed from the sea as to have scattered over its surface not only beach pebbles, but frequent sharks' teeth and occasionally jawbones of whales, from the latter of which the villagers construct the crucifixes they always plant upon some prominent headland. Further inland there is a broad peneplain nearly 6,000 feet above the sea level, fringed by an old sea-beach of rolled pebbles more or less covered by beds of volcanic tuff.

The geological formations along the coast belt, as far as observed, are mostly granites and diorites, in places surrounded by horizontal or slightly crumpled beds from which fossils of probable Miocene and Pliocene age were obtained. To the former apparently belong the very considerable extent of petroleum-bearing beds in northern Peru near Cape Blanco. The main mass of the western crest of the Andes, where observed, consists of closely compressed, infolded limestones, slates and conglomerates, with intrusive andesites and other igneous rocks. These sedimentary beds are thought to be of probable Jurassic age, though no fossils were obtained.

The Telluride mining district, in the San Juan mountains, was described by Mr. C. W. Purington. It is situated in southwest Colorado, on the line of the Rio Grande Southern Railway. It is a mountainous region characterized by precipitous topography. The mountains rise to 14,000 feet from a plateau of 7,000, which bounds the region on the west. The rocks are nearly flat-bedded sedimentaries of Triassic, Jurassic and Cretaceous age, overlain in the eastern part of the quadrangle unconformably by a heavily bedded conglomerate, 200 feet thick, above which lie 2,000 feet of andesitic breccias, in part waterlaid, and still higher 1,000 feet of volcanic flows, andesite and rhyolite. Diorite stocks of large dimensions have cut all the other rocks of the region and are most recent in age. Surface denudation has exposed them to view. The centers of volcanic activity lies to the east of the sheet.

Several well-defined fissure-systems, due to the action of extraneous forces, penetrate the rocks of the region. The systems are characterized by the alternation of widely and narrowly spaced zones of fissures. The zones of narrowly spaced fissures vary from one to ten feet in width, and it is along these that the workable veins are found. Relative movement of the walls of the closely fissured zones, accompanied by trituration of the included rock, developed open space which the ore now occupies. The veins carry gold, mostly free, but in part combined with metallic sulphides, silver mostly in galena and freibergite, less frequently as stephanite, pyrargyrite, polybasite, etc. Beside iron, lead, copper and zinc sulphides, there occur as gangue, predominating quartz, carbonates, barite, fluorite, sericite and other minerals in small amount. Gold and silver veins occur closely associated. Accompanying the veins the wall rocks are altered, and impregnated with iron pyrite, occasionally auriferous. The values vary between wide limits. They must be given in more detail than is possible here. The veins show remarkable continuity in length, one having been profitably worked for a distance of more than two miles.

The ore is of Tertiary age, is of deep-seated origin, and has been deposited from solutions; $20,000,000 is a low estimate for the product of the district. It has steadily increased in importance since 1875, and very rapidly within the last five years. Formerly silver was the principal product; now much the larger output is in gold.

W. F. Morsell.
U. S. Geological Survey.

New York Academy of Sciences—Section of Geology, May 17, 1897.

The first paper of the evening was by Mr. D. H. Newland, entitled 'Occurrence and Origin of the Serpentines near New York.' Mr. Newland spoke of the occurrence of Serpentines in the vicinity of New York and classified them according to origin into two probable divisions; one including those from New Rochelle and Hoboken, possibly derived from metamorphosed igneous rocks, and second, those from the other

localities more probably derived from some form of sedimentary rock.

The second paper of the evening was by Professor J. F. Kemp, entitled 'Notes on Butte, Montana, and its Ore Deposits.' Professor Kemp described the geological position of the copper and silver bearing ore rocks of Butte, and illustrated his talk with a number of lantern slides made from photographs in the region last summer. He spoke particularly of the geological succession exhibited in the relationship of two forms of granite, an earlier basic and a later acitic cut by later rhyolite flows.

The third paper was by Professor Kemp, entitled 'Notes on the Geology of the Trail from Red Rock to and beyond Leesburg, Idaho.' This paper brought forth the first account known of the geology of about 100 miles of the trail mentioned, where the rocks are very varied in character, but mostly early Cambrian quartzites, together with many igneous rocks including Tertiary rhyolites. The ore producing region is found in the valleys where the gravels are washed in some places by hydraulic force and some gold gained therefrom.

The last paper of the evening was by Professor C. A. Doremus, and was illustrated by a series of specimens received from France from M. Moissan, representing certain of the metals and carbides formed by the electric furnace. Some of these were very interesting geologically, because of their peculiar properties; particularly the carbonates of aluminum, calcium and cerium, which latter, when tested with water, produces all the series from marsh gas to the heavier petroleum products. The specimens exhibited are for final placement in the National Museum at Washington, D. C.

This being the last meeting of the Geological Section before the summer vacation, adjournment was made until October.

RICHARD E. DODGE.
Secretary.

THE TORREY BOTANICAL CLUB, MARCH 31, 1897.

THE first paper, by Dr. Albert Schneider, 'The Phenomena on Symbiosis,' and a paper by Leonard Barron on 'Horticulture in Botanical Gardens,' were read by title, owing to unavoidable detentions.

The evening was occupied by a paper by Professor Edward S. Burgess, on '*Aster macrophyllus and its allies*,' illustrated by chart of relationship and by numerous specimens. The speaker sketched the history of the species *Aster macrophyllus*, in which it has been the custom of American botanists to include all large-leaved asters. He showed how diverse these asters are and in what confusion their assignment to a single species results, and indicated the characters according to which they form two groups, each of several species and varieties.

The paper, which will soon appear in print, was discussed by Mr. E. P. Bicknell, who confirmed the distinctions offered, by the results of his observations about New York, and by Dr. Britton, who paid a tribute to the masterly manner in which Dr. Gray has treated the subject of the genus *Aster*, so far as material was then available, and who referred to the special need for extended field-work and further collaboration which this genus has long presented.

APRIL 13.

DR. ALBERT SCHNEIDER presented a paper entitled 'Methods employed in the examination of powdered drugs and their adulterations.'

He described certain microscopic structural features which he had investigated with a view to find characters by which to distinguish the more important drugs, giving details of such characteristics determined by him for mace, senna, leaves of Eucalyptus globulus, etc.

Dr. Britton spoke of the utility of this work and of its object, in behalf of the new edition of the U. S. Pharmacopœia.

The paper was followed by an early adjournment to facilitate the attendance of members upon the annual exhibit given by the New York Microscopical Society.

EDWARD S. BURGESS,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met April 7th, with thirty-two persons present. Professor J. Eliot Wolff spoke of the occurrence of tourmalines at Mt. Mica, Paris, Me., and gave an account of the locality, with a history of its discovery. Sev-

eral varieties were described; also the minerals formed in the rocks associated with the tourmalines. Two kinds of gem tourmaline were recognized and their occurrence in cavities or pockets noted. Professor Wolff showed a series of tourmaline crystals, including two of the largest yet discovered; also a number of the original plates illustrating Mr. Hamlin's 'History.'

Dr. Charles B. Davenport discussed the *rôle* of water in growth. Organic growth was defined as an increase in volume. The definitions given by others were reviewed and analyzed. The processes of growth were analyzed and the factors involved in growth noted. The experiments and observations of plant physiologists assign the principal *rôle* to water in the growth of plants. Experiments made to determine the percentage of water in the body of developing tadpoles at different stages show that growth is due chiefly to imbibed water. The *rôle* of water in the development of organisms and its bearing on the meaning of curves of growth were discussed in detail.

SAMUEL HENSHAW,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the evening of May 17, 1897, twenty-six persons present, a committee appointed at an earlier meeting presented a short biographic sketch of the late Dr. James N. Leete, for many years an active and influential member of the Academy.

Mr. J. B. S. Norton read a paper embodying the results of an examination into the effects of the tornado of May, 1896, on trees about St. Louis, in which it was shown that, while ordinary winds have some influence on the form and strength of trees, in strong winds uprooting is caused by wet soil, weak spreading roots and a large surface exposed to the wind. If the roots hold, breaks may occur in the trunk or branches, depending on the strength of the wood, the form of the tree, the mode of branching and the weight and resistance of foliage. While the edge of dry leaves presented to the wind offers little resistance, when foliage is wet and massed this may be very different. Local variations in these several factors make a comparison of different species difficult. It was shown that *Acer dasycarpum* was badly broken on account of its brittle wood and heavy foliage, while the weak-wooded *Tilias* and *Liriodendrons* were also broken. Spreading-topped trees, like *Ulmus Americana*, as a rule, were broken and uprooted, though the branches were only bent in the tougher-wooded individuals. As a general thing, conical trees, like *Ulmus campestris*, *Liquidambar* and most conifers and the strong-wooded oaks, were little injured. *Taxodium distichum*, from its slender form, strength and elasticity, was injured least of all. It was shown that after the tornado, which occurred early in the vegetative period, most of the trees continued the summer's growth by producing new foliage shoots. While a few died from the inability to secure food, others indicate injury by flowering and fruiting more profusely than usual. It was shown that some of the trees which were broken have already begun to show serious decay where the branches were removed, so that the final injury can hardly yet be measured.

The results observed here were compared by the speaker with those which have been reported from time to time in connection with severe storms elsewhere.

The paper was discussed by Mr. H. von Schrenk, who submitted some interesting specimens, slides and drawings illustrating the formation of a double ring in 1896, resulting from the refoliation of the branches denuded shortly after the season's growth had begun.

WILLIAM TRELEASE,
Secretary.

NEW BOOKS.

L'évolution régressive en biologie et en Sociologie. JEAN DEMOOR, LEAN MESSURT, ÉMILE VANDERVELDE. Paris, Alcan. 1897. Pp. 324.

Guide to the Genera and Classification of the North American Orthoptera found North of Mexico. SAMUEL HUBBARD SCUDDER. Cambridge, Edward W. Wheeler. 1897. Pp. 87.

The Entropy Temperature Analysis of Steam Engine Efficiencies. SIDNEY A. REEVE. New York, Progressive Age Publishing Co. 1897. Pp. 250.